DINOSAUR DREAMING
2021 FIELD REPORT

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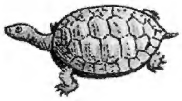

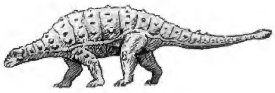

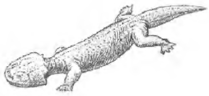

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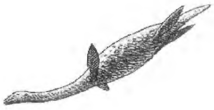

Dinosaur Dreaming acknowledges the Bunurong and Eastern Maar peoples, the Traditional Owners of our Victorian Cretaceous dig sites, and pays respect to their Elders past and present.

FRONT COVER: Melissa Finds a Dinosaur Footprint by Sharyn Madder.
INSIDE FRONT COVER: Cretaceous animal images by Peter Trusler.
BACK COVER: Ornithopods by Ruairidh Duncan.

Collection of Victorian Cretaceous material is completed under the National Parks Act 1975 Research Authorization Permit No 10009432 from the Department of Environment, Land, Water and Planning granted to Prof Patricia Vickers-Rich, Monash University, 9 Rainforest Walk, Clayton, Victoria, and associates under the direct supervision of the authorisation holder.
Date of Issue: 11 May 2020. Date of Expiry: 01 June 2023.

The Dinosaur Dreaming 2021 Field Report was compiled and edited by Wendy White. The editor would like to thank her proofreaders Alan Tait, Lesley Kool and Mary Walters.

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AND OUR BLOG: *www.dinodreaming.blogspot.com*

Image: W White

WEEKEND WARRIORS

6th February to 23 May 2021

BY LESLEY KOOL

Ongoing COVID-19 restrictions once more postponed the planned field trip to the Eric The Red West locality in the Otway Group. To appease some of the more enthusiastic Dinosaur Dreamers I organised "Weekend Warriors" field trips that were designed to sample some of the new sites along the Bass Coast that Melissa Lowery had discovered over the last 12 – 18 months. Sites such as Melissa's Mine, Mary Anning and Noddyland were sampled over selected weekends in the hope that one of them may turn out to be as rich as the Flat Rocks site.

Saturday 6th February — Melissa's Mine

Low tide: 1:00 pm

Results

This site was selected because Melissa Lowery had found approximately nine small bones in the fossil layer in the past twelve months. On Friday 5th February Doris and Mary met up with Melissa at the site so that Doris could map the area. In the process, Melissa found a further four small bones in the layer.

The fossil layer is only about 50 – 60 centimetres wide but stretches about 5 – 6 metres. Most of the small bones were found within a 2 – 3 metre span which is the area that was sampled. Although Alan and John Swinkels did sample a small section further along, they found nothing.

Along with the four surface bones found the day before, seven small bones were discovered during the sampling, five of which were scrappy turtle fragments. Joerg found a small phalanx, which fell apart as it became exposed. Mike found what could be the edge of either a spongy centrum or phalanx. Wendy volunteered to prepare the bone.

While the crew was sampling the layer Melissa rediscovered a bone she had found previously approximately 100 metres west of the fossil layer. Mike cut out the bone, which appeared to be the edge of a small vertebra. Wendy volunteered to prepare it.

After lunch Melissa took Doris to visit the next site, Mary Anning, approximately 500 metres west of Melissa's Mine.

Most of the rock sampled was processed on site except for eight buckets of rock that were transported to Lesley's shed in Wonthaggi for processing at a future date.

Sunday 7th February — Mary Anning

Low tide: 1.50 pm

Weather was overcast with a few light showers but not enough to prevent the team from assembling at the Mary Anning site at 10.30 am.

Mike Cleeland named this site after English amateur fossil collector Mary Anning when a plesiosaur rib was found here in the 1990s.

Melissa pointed out where the fossils she had found in the past were located within the layer. Alan and the two Johns proceeded to excavate. Doris had visited the site the day before and had divided it into three sub-sites.

Site A was a small area of thick conglomerate close to the base of the cliff where the plesiosaur rib had been found a number of years earlier. This rock turned out to be particularly hard and minerally cemented.

Site B was approximately 5 metres east of Site A on the shore platform and was the layer that most of the bones Melissa had found had come from.

Site C was an extension of Site B, approximately 5 metres south on the shore platform. The conglomerate at this site was more of a typical grey, small clast conglomerate, compared with Site B, which had quite a large amount of iron staining. However the layer is quite thin, about 5 centimetres deep and didn't seem to go very far.

Results

At Site A, a weathered centrum, a tiny oval cross-section and a scrappy fragment of fish were found on the surface by Melissa. No bones were found in processing but only a small amount was broken up as the rock was particularly hard.

Site B yielded a number of bones during processing:

1. Joerg's possible plant (Lesley to check)
2. Sharyn's metallic-looking speck (Lesley to check)
3. Wendy's fishy bit
4. Dense plate in 2 parcels
5. Lesley's small ankylosaur osteoderm

Image: W White

The beach is beautiful at Melissa's Mine

At Site C, no bones were exposed on the surface, but three bones were recovered when a small amount of rock was processed.

1. Mary's two small bones
2. Mary's edentulous fish jaw

Results

Melissa will keep monitoring the site for newly exposed bones. Sites A and B did not appear very productive, despite the discovery of an ankylosaur osteoderm. Site C has some potential and it might be worth returning to remove more of that layer.

Saturday 20th February — Noddyland

Low tide 12.20 pm

Weather was again overcast with a couple of light showers during the morning.

Results

On arrival Melissa found two small bones in a conglomerate layer at the base of the cliff.

Four sub-sites within Noddyland were sampled.

- "Sherlock" – closest to the base of the cliff where Melissa had found a number of bones in the past. Rohan and Ruairidh excavated a small amount of rock, targeting a thin conglomerate associated with a small tree trunk. No bones were recovered.
- "Watson" – approximately five metres south of Sherlock in another area where surface bones had been collected. Nick and John excavated this area. Two surface bones were found prior to excavation but no bones were recovered in the rock.
- Noddyland Offshore: After lunch Nick, John, Dean, Rohan, Ruairidh and Doris explored the outer reef at low tide, samples of rock were taken and three scrappy bones were recovered including a small hollow infilled shaft, which after later preparation turned out to be incomplete with no ends.
- A large erratic close to the base of the cliff where five surface bones had been collected in the past yielded a small scrap of bone.

Image: L Kool

Joerg Kluth and John Swinkels sampling Mary Anning Site C

Sunday 21st February — Noddyland

Low tide 1:00 pm

Weather: Cloudy with short bursts of sunshine. Perfect.

Results

Left over rock from the previous day, that had been stashed above high tide mark, was processed.

Two more sub-sites were sampled:

- An erratic close to the cliff that Melissa had pointed out to Nick the previous day was broken up and yielded two small bones (partial fish jaw and a small limb) and a suspicious specimen that turned out to be a brown mud clast.
- Samples of concretions from where the concretion containing Noddy (partial articulated ornithopod skeleton) was found in 2010. None of the concretions sampled contained any bone.

Melissa, Mike, Doris and Alan explored further along the coast and collected a number of bones from Ankylosaur Point (fishy scrap and open-celled cross-section) and Swim O'clock (hollow limb in cross-section) localities.

The absence of a quantity of bones under the area where multiple bones had been collected in the past means that Noddyland is not a site to return to in the near future. Melissa and Mike will continue to monitor the area for newly exposed bones.

Saturday 20th March — Ankylosaur Point

Low tide 11:40 am

Weather: Warm, sunny 25°C

Results

Ankylosaur Point is named for the first fossil bone that was discovered there, which was an ankylosaur rib. Subsequently a number of bones have been found there, including a plesiosaur tooth and an ornithopod dentary.

The area close to the base of the cliff, where the majority of surface bones had been collected in

Image: W White

Ruairidh Duncan sampling Noddyland

the past, was sampled extensively. Thirteen small bones were recovered from processing the rock sampled, some so tiny they had to be subsequently checked under the microscope. Melissa found three surface bones, all small.

Alan Tait has been mapping the sedimentology of the area and indicated that the sampled fossil layer was a pocket of conglomerate that was separate from the main conglomeratic layer that could be seen out onto the shore platform. He traced the layer and plotted it on his map but indicated that the layer was thin and patchy and not worth sampling. There were no old saw cut marks in the layer on the shore platform, which was also a good indication that it was relatively unfossiliferous.

At the end of the day it was decided that Melissa and Mike should periodically return to Ankylosaur Point to check for newly exposed bones in the "pocket" at the base of the cliff.

Sunday 21st March — Swim O'clock Rock offshore

Low tide 12 noon

Weather: Cloudy and windy

Swim O'clock Rock is the name given to a small exposure of fossil layer approximately 250 metres north of the main Flat Rocks dig site, near The Caves. It got its name from the nearby shallow inlet where the Dinosaur Dreaming crew would cool off during the annual digs. "Swim O'clock!" was the cry used to let the crew know that they were welcome to take a break from rock breaking and excavating and take a refreshing dip in the cool water. Most of the time that area is under sand but occasionally the sand shifts to reveal a small patch of conglomerate that has yielded a number of bones in the past.

During the Dinosaur Dreaming 2011 field season a small team mapped and sampled the layer over a three day period which resulted in a number of small bones, mainly turtle, fish and ornithopod.

Image: W White

Nick van Klaveren, Alison Dorman and John Wilkins clean rocks at Ankylosaur Point

Since then Mike and Melissa have found more bones further offshore from the layer at the cliff base, including an ornithopod femur, an unidentified jaw and a small theropod vertebra, and so it was decided to sample that area. According to Alan Tait, who was one of the team who sampled the original Swim O'clock Rock in 2011, the surface conglomerate offshore is probably not the same layer as the original layer.

Results

Rock samples were taken in the vicinity of old rock saw cuts but only two scrappy bones were recovered. However, Melissa found 15 surface bones scattered over the offshore area, including a possible tooth, a piece of turtle shell and an interesting shape within three metres of each other.

The fact that so few bones were recovered during the rock processing determined that we would not need to return in the near future, but Melissa will continue prospecting the area for newly exposed bones.

Sunday 25th April — Koonwarra rock at Fish Creek

The weather forecast for the weekend of the 24th/25th April was quite dismal and so it was decided to postpone the planned return to the Mary Anning site for a month or so. As it looked like Sunday could also be quite wet we arranged to visit the property of weekend warrior Gary Wallis in Fish Creek, where he has approximately six tonnes of rock fragments collected from close to the Koonwarra Fish beds. Gary had organised with Major Road Projects Victoria to supply us with a small amount of rock that had been excavated during the realignment of the South Gippsland Highway between Koonwarra and Meeniyan. We will process the rock in the hope of finding tetrapod remains, which have been elusive so far. Many fish fossils, together with beautifully preserved insects and plants have been recovered in this rock, but so far (except for 10 feathers found many years ago), there is no evidence of tetrapods, not even a hint of turtles, which are ubiquitous throughout the Bass Coast sites of the same age.

The rock is stored in a large open shed on Gary's picturesque property and there was plenty of room for around 20 weekend warriors to sit and process the material. Gary was the consummate host, providing hot water for tea and coffee, as well as biscuits, cheese and dips. The team was quite spoilt and I am hoping they won't expect this standard of treatment on our future samplings.

Even though the rock pieces were generally quite small most of the team managed to find good examples of insects and plants, including a possible cockroach (125 million years old, not a live one) and a weevil. Images of some of the insects have been sent to palaeoentomologist Sarah Martin in Western Australia for identification.

Because of Gary's generosity, we can now be much more flexible in our future plans. If the weather is inclement on the designated days we plan to sample along the Bass Coast we now have the option of staying dry and processing more of the Koonwarra rock.

Saturday 22nd May — East of Eagles Nest

Low tide 12:35 pm.

Weather: warm and sunny

The exercise for the day was to try and measure, map and trace the individual dinosaur tracks that Melissa had found on the shore platform close to Eagles Nest. Melissa pointed out the tracks to the group and Doris Seegets-Villiers was in charge of collating the mapping. Unfortunately it was not a low low tide and some of the seaward tracks remained covered by water for the duration of the exercise. The team worked together on the first track to work out the best way to measure and map it.

Once they had worked out a system, the team split into groups and with Melissa's guidance, began to mark more of the tracks.

This took longer than was planned and by the time the tide began to come in again, it was obvious that the team would need more than one day to map and measure all the tracks in that area.

However, the exercise was a success in that Doris was able to formulate a system of measurements that meant that when the team returns in the future the data collection would be more streamlined. In the meantime, Melissa will be on the look-out for more dinosaur tracks along the wonderful Bass Coast of Victoria.

Sunday 23rd May — Lesley's Driveway in Wonthaggi

Low tide 1:35 pm

Weather: overcast

It was obvious that continuation of the mapping and measuring of the dinosaur trackways needed a really low tide, when the team would have more time to collect data when the tide was out. As low tide on Sunday was at 1.35 pm and was a high low tide it was decided that the mapping exercise would be postponed until closer to summer when low tides were regularly lower than other times of the year.

As compensation, the team was invited to Lesley's home in Wonthaggi to participate in a rock breaking session. Some of the rock sampled from sites visited earlier in the year had been stored in Lesley's shed and so a pleasant day was spent, sitting in a circle, chatting, drinking tea/coffee, consuming yummy goodies and breaking up the accumulated rock. Unfortunately, no great discoveries were made but everyone enjoyed the social exercise.

Unfortunately, the rest of our 2021 plans have so far been thwarted by a series of COVID-19 lockdowns and the team has been unable to return to Fish Creek or the Bass Coast. Hopefully, when restrictions are lifted and people can travel to Regional Victoria we will get together again and continue our great adventure.

Weekend Warriors 2021 included:

- Mike Cleeland
- Kim Douglas
- Ruairidh Duncan
- Alan Evered
- Nicole Evered
- Fotini Karakitsos
- Joerg Kluth
- Lesley Kool
- Miklos Lipcsey
- Rohan Long
- Aidan Lowery
- Melissa Lowery
- Sharyn Madder
- Nicola Sanderson
- Doris Seegets-Villiers
- John Swinkels
- Alan Tait
- Nick van Klaveren
- Gary Wallis
- Mary Walters
- Wendy White
- John Wilkins
- Dean Wright

Image: L Kool

Measuring footprints near Eagles Nest

Image: Museums Victoria

MELISSA EARNS A NICKEL

BY TOM RICH

“Never make a promise that you think you will never have to keep”. I learned this lesson at Dinosaur Cove. After about five years there, with no mammal having turned up, one of the crew, a confirmed chocoholic, asked me what I would give if a mammal was found. Flippantly, I promised a cubic metre of chocolate. Two years after digging there ceased, the holotype of *Kryoryctes cadburyi* turned up, quite clearly a monotreme. Fortunately, another member of the crew, Cindy Hann, knew the manager of Cadbury Ringwood. Asked if the company would help to honour my promise, he replied in a favourable manner. Hence the species name of *Kryoryctes cadburyi*.

However, never again. So when Melissa Lowery started finding all sorts of tiny fossils as well as ichnites on the Bass Coast, it seemed that, sooner or later, her efforts would be rewarded by a mammal. Wanting to encourage her in this, but unwilling to make a rash promise quite as grandiose as a cubic metre of chocolate, I settled on something much more modest, a US nickel worth five cents.

So when the inevitable day came when Melissa did find her first mammal (Fig. 1) at the Honey Locality, I was prepared to honour that rather modest promise. This fossil comes from the Honey Locality, which means that there is now a second Cretaceous mammal locality on the Bass Coast. Not a bad effort for Melissa’s first mammal find!

The specimen has been only partially exposed as it is fragile and the enclosing matrix quite hard. Joseph Bevitt 3D-scanned the fossil at the Australian Synchrotron, and Matt White has prepared images with that data. Because Joseph and Matt can do this, it is no longer necessary for such specimens to be fully extracted from the rock in order to study them.

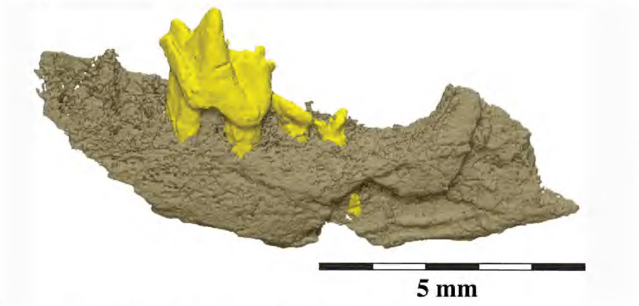


Image: courtesy of T Rich

Figure 1. Melissa’s mammal jaw

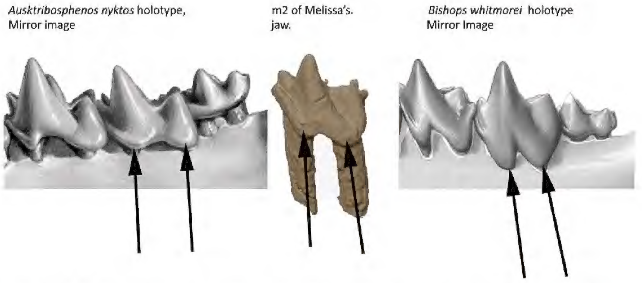

Ausktribosphenos nyktos holotype,
Mirror image
m2 of Melissa’s.
jaw.
Bishops whitmorei holotype
Mirror Image
Image: courtesy of T Rich

Figure 2: Melissa’s jaw with Ausktribosphenos *and* Bishops.

The specimen is clearly an ausktribosphenid. Given its size, it is unlikely to be a third specimen of *Kryoparvus gerriti*. That leaves *Ausktribosphenos* and *Bishops* as the most likely candidates. Which of those two it most likely belongs to is not immediately obvious. But there are two features suggesting it is more likely to be *Ausktribosphenos*.

As illustrated in Figure 2, the enamel crown of the second molar (m2) of *Bishops* extends downward along the outside of the tooth roots. By contrast, on *Ausktribosphenos* and Melissa’s specimen, the crown does not do that where the bottoms of the enamel crown on the teeth are indicated by black arrows.

On well preserved specimens of *Ausktribosphenos*, the first molar (m1) is a noticeably larger tooth than m2. On *Bishops*, the situation is just the opposite. Melissa’s jaw does not have the m1 preserved. However, there is a faint trace of the alveoli for the roots of that tooth. It would seem to have been somewhat larger than the m2 and thus similar to *Ausktribosphenos* (Fig.3).

So on these two features, weak though they are, at this time I would wager that Melissa has found another specimen of *Ausktribosphenos*.

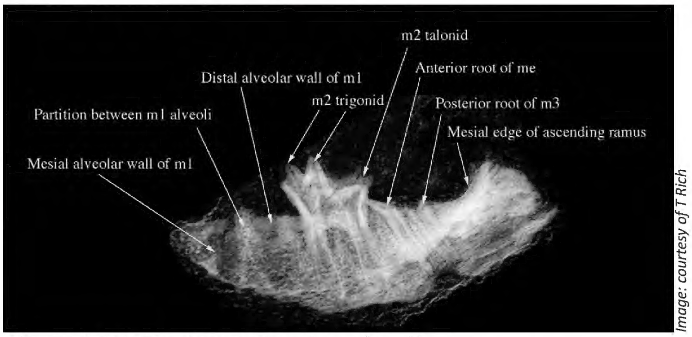

m2 talonid
Anterior root of me
Distal alveolar wall of m1
m2 trigonid
Posterior root of m3
Partition between m1 alveoli
Mesial edge of ascending ramus
Mesial alveolar wall of m1
Image: courtesy of T Rich

Figure 3. Melissa’s jaw showing alveoli

Image: Museums Victoria

WENDY'S JAW

BY TOM RICH

In the usual course of events, if a new species of fossil is described on the basis of a partial specimen and subsequently a more complete specimen is found, it is to be reasonably expected that a better understanding of its placement in the family tree is the outcome.

However, the description of a second specimen of *Corriebaatar marywaltersae*, found by Wendy White had a quite different outcome.

When first described in 2009, *Corriebaatar marywaltersae* was known primarily by a plagiaulacoid (fan-shaped) tooth, a premolar so typical of advanced multituberculate mammals. And so it was tentatively placed there. If that assignment is correct, it was the first example of that group of mammals in Australia. The rodent-like multituberculates are quite common in the Mesozoic and early Cenozoic of the Northern Hemisphere and some occur in South America.

Wendy's jaw had the same typical plagiaulacoid tooth as the holotype. If one restricted the allocation of the second specimen to that tooth, it, too, would be tentatively placed in the multituberculates. However, Wendy's specimen had much more present than that tooth. Just over half the mandible was preserved. In it could be seen the alveolus for a prominent anterior incisor and behind the premolar, two small alveoli presumably for a single small molar or possibly two even more diminutive single-rooted teeth of some kind. At the preserved rear end of the lower jaw appeared to be just a trace of the anterior part of the base of an angle.

Typically, multituberculates have two or more prominent molars behind the last premolar and do not have an angle on the lower jaw. So if in light of Wendy's jaw, *Corriebaatar marywaltersae* is in fact a multituberculate, it is certainly an outlier of the group. If not a multituberculate, what is it? It simply does not fit comfortably anywhere in another known mammalian group. Are we seeing the first representative of a major group of mammals not previously encountered? Could be. After all, there are less than 100 specimens known of Australian Mesozoic mammals and this continent has been rather isolated since the Cretaceous. So another group as unique to Australia as the monotremes is certainly a possibility.

At about the same time the above was written, a manuscript about Wendy's Jaw was submitted for publication in *Acta Paleontologica Polonica* with these uncertainties presented as very much a part of it. The manuscript was sent out to two reviewers who carefully went over the arguments. Their unanimous opinion was that the initial hypothesis published about *Corriebaatar marywaltersae* in 2009 was correct. This was based primarily on a disagreement about a single important character, the evidence for the presence of an angular process. The structure on the jaw that had been interpreted by me to be a remnant of the most anterior part of the angular process was simply too far forward to be that when compared to all other mammals that have an angular process. These reviewers made me carefully go back and check this point. So now once again I think *Corriebaatar marywaltersae* is what it was thought to be in 2009. Scientific hypotheses are always up for review and this change of opinion is just one example. But who can say if yet more complete material of *Corriebaatar marywaltersae* is found it will continue to be interpreted as an advanced multituberculate?

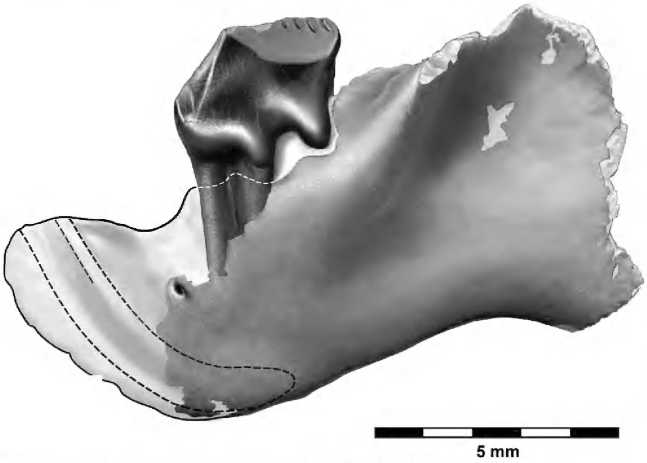


Image: P Trusler

Reconstruction of the new jaw NVM P252730

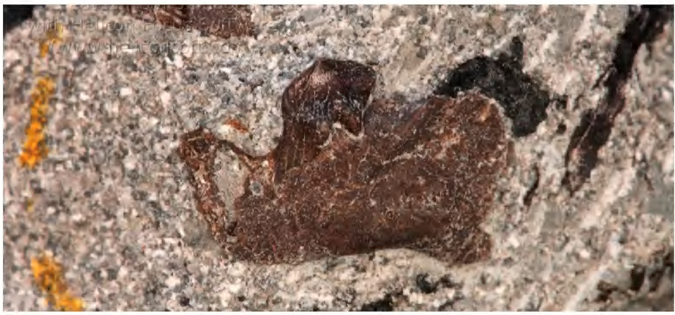


Image: L Kool

The new jaw the day after Wendy White found it, with light preparation by Lesley Kool

Image: Museums Victoria

RECENT PUBLICATIONS

BY TOM RICH

In previous field reports, mention has been made of a number of Cretaceous mammals, the study of which were underway. In the past year, a number of these have been formally published.

Gerry's Jaw

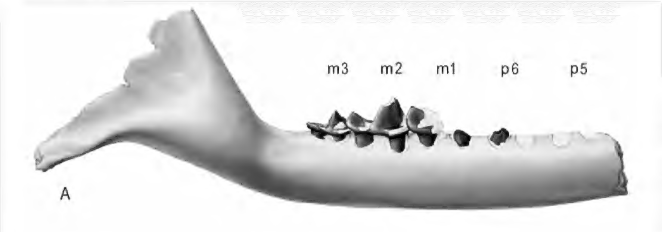


Image: P Trusler

Rich, T.H., Trusler, P., Kool, L., Pickering, D., Evans, A., Siu, K., Maksimenko, A., Kundrat, M., Gostling, N.J., Morton, S. and Vickers-Rich, P., 2020. A Third, Remarkably Small, Tribosphenic Mammal from the Mesozoic of Australia. In *Biological Consequences of Plate Tectonics* (pp. 67-75). Springer, Cham.

Stirtodon, large monotreme from Lightning Ridge

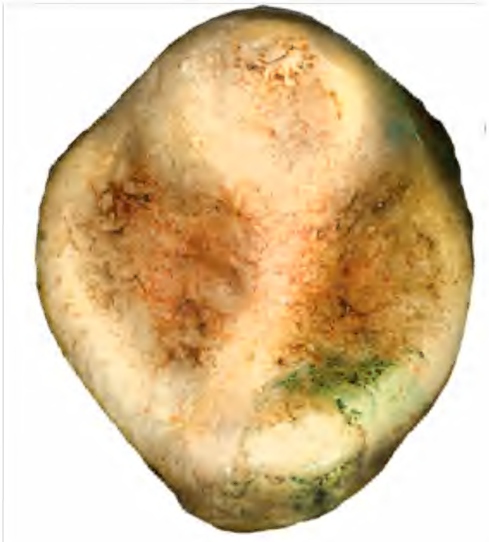


Image: P Trusler

Rich, T.H., Flannery, T.F. and Vickers-Rich, P., 2020. Evidence for a Remarkably Large Toothed-Monotreme from the Early Cretaceous of Lightning Ridge, NSW, Australia. In *Biological Consequences of Plate Tectonics* (pp. 77-81). Springer, Cham.

Tim Ziegler's *Sundrius ziegleri***.**

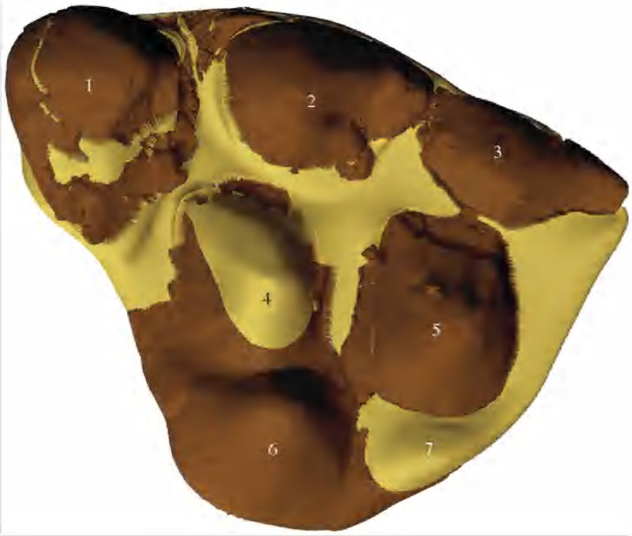


Image: P Trusler

Alanna Maguire's *Bishops* upper molars.

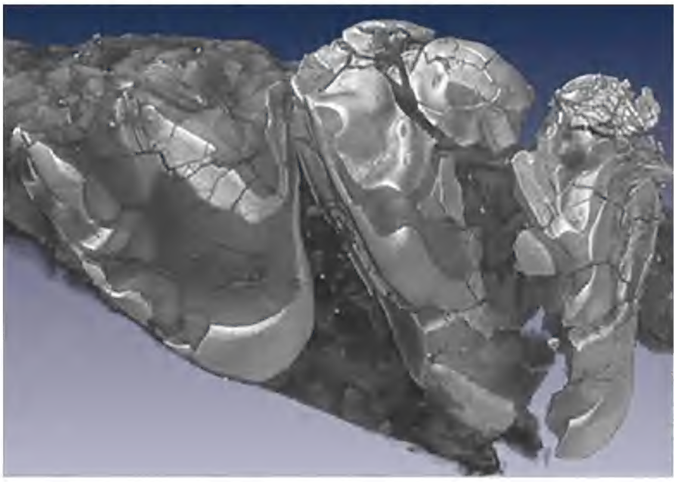


Image: P Trusler

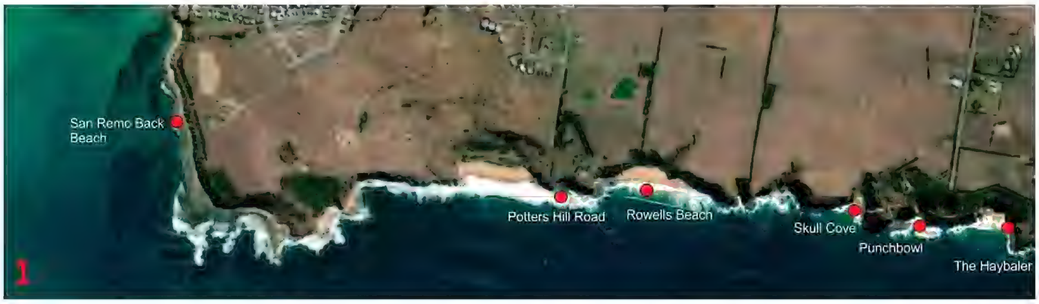
Rich, Thomas H., Timothy F. Flannery, Alistair R. Evans, Matt White, Timothy Ziegler, Alanna Maguire, Stephen Poropat, Peter Trusler, and Patricia Vickers-Rich 2020. Multiple hypotheses about two mammalian upper dentitions from the Early Cretaceous of Australia. *Alcheringa: An Australasian Journal of Palaeontology* 44(4): 528-536.

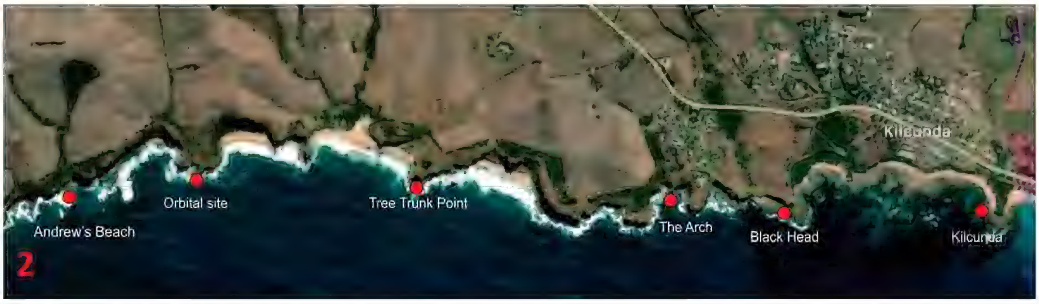
THE MAMMALS OF VICTORIA'S CRETACEOUS

Reg #	Taxonomy	Collector	Field Number	Date Found	Preparator	Notes
P208090	*Ausktribosphenos nyktos*	N. Barton	#1111	1997	L. Kool	HOLOTYPE. Right. P6, M1-3
P208094	*Kryoryctes cadburyi*		Dinosaur Cove	1993	L. Kool	HOLOTYPE. Right humerus. Slippery Rock Pillar, Dinosaur Cove
P208228	*Bishops* sp.		#329	1995	L. Kool	600my Exhibition display. Right. P4-M2
P208230	*Ausktribosphenos* ?			1995	L. Kool	Edentulous jaw fragment
P208231	*Teinolophos trusleri*		Mentors trip	Nov. 1993	L. Kool	HOLOTYPE. M3 or M4
P208383	Monotremata		Dinosaur Cove	1993	L. Kool	Premolar. Slippery Rock Pillar, Dinosaur Cove
P208482	*Ausktribosphenos nyktos*	N. Gardiner	#150	1999	L. Kool	Right. M2-3, badly crushed. Found in rock from DD1998
P208483	Ausktribosphenidae ?	N. van Klaveren	#140	1999	L. Kool	Probably Left. x1 premolar & partial tooth
P208484	*Bishops whitmorei*	K. Bacheller	#450	1999	L. Kool	Right. M2
P208526	*Teinolophos trusleri*		#560	1994	L. Kool	Right. Edentulous
P208580	Mammalia	A. Maguire	#200	2000	L. Kool	Jaw fragment. (unprepared)
P208582	Ausktribosphenidae	L. Irvine	#500	2000	L. Kool	Right. M3
P209975	*Bishops whitmorei*	R. Close ?	#387	2000	L. Kool	Right. Roots M1, worn M2. OK M3
P210030	*Teinolophos trusleri*			2000	L. Kool	Right. Edentulous
P210070	*Bishops whitmorei*		Rookies day	03.12.2000	L. Kool	Right. Badly broken M1, M2 and x6 Premolars
P210075	*Bishops whitmorei*		Rookies day	03.12.2000	L. Kool	HOLOTYPE. 600my Exhibition display. Left. P2-6, M1-3. (P1 lost since initial preparation)
P210086	Ausktribosphenidae ?	J. Wilkins	#250	2001	L. Kool	Right. Root fragment
P210087	"Gerry's jaw"	G. Kool	#620	2001	L. Kool	Right. Rear half M1, M2-3
P212785	Mammalia	M. Anderson	Rookies day	03.12.2000	L. Kool	Fragment only
P212810	*Bishops whitmorei*		#300	2002	L. Kool	Left. M2-3
P212811	*Teinolophos trusleri*	D. Sanderson	#187	2002	L. Kool	Right. Edentulous
P212925	Mammalia ?		#222	1996	D. Pickering	Edentulous
P212933	*Teinolophos trusleri*		#179	2001	L. Kool	Left. Edentulous. (Plus associated molar)
P212940	"Gerry's jaw"	W. White	#171	2003	D. Pickering	Left. M1, M2-3
P212950	*Bishops whitmorei*	C. Ennis	#292	2003	L. Kool	Left. P6, M1-3
P216575	*Teinolophos trusleri*	N. Gardiner	#180	2004	D. Pickering	Left. x2 molars. Probably M2-3
P216576	Mammalia	A. Musser	#500	2004	L. Kool	Isolated tooth
P216578	*Bishops whitmorei*	A. Leorke	#600	2004	D. Pickering	Left. M1-3
P216579	*Teinolophos trusleri*	N.van Klaveren	#635	2004	L. Kool	Edentulous jaw
P216580	*Bishops whitmorei*	G. Kool	#800	2004	D. Pickering	Right. P6, M1-3
P216590	*Teinolophos trusleri*	J. Wilkins	#447	2004	D. Pickering	Posterior part of right edentulous jaw
P216610	*Teinolophos trusleri*		#557	2004	L. Kool	Left. Edentulous
P216655	*Corriebaatar marywaltersae*	M. Walters	#142	2004	L. Kool	HOLOTYPE. Multituberculata. Left. P4
P216670	*Ausktribosphenos nyktos*		#184	1999	L. Kool	Left. M2-3
P216680	*Teinolophos trusleri*	R. Long	#132	2004	L. Kool	Right. Fragment
P216720	*Teinolophos trusleri*		#648	2002	L. Kool	Right. Edentulous
P216750	*Teinolophos trusleri*	R. Long	#162	2005	D. Pickering	Right. Edentulous
P221043	*Bishops whitmorei*	A. Leorke	#100	2005	D. Pickering	Right. M1-2?
P221044	Ausktribosphenidae	C. Ennis	#300	2005	D. Pickering	Left. M2
P221045	*Teinolophos trusleri*	J. Wilkins	#395	2005	D. Pickering	Right. Edentulous
P221046	Mammalia	H. Wilson	#480	2005	L. Kool	Isolated tooth
P221150	*Teinolophos trusleri*	J. Swinkels	#340	2006	D. Pickering	600my Exhibition display. Right. x2 molars. Probably M2-3
P221156	Ausktribosphenidae	N. van Klaveren	#360	2006	D. Pickering	Right. M2 (requires preparation to confirm)
P221157	*Bishops whitmorei*	M. Walters	#585	2006	D. Pickering	Right. Edentulous with alveolae for P6, M1-3
P221158	*Bishops whitmorei*	R. Close	#200	2006	D. Pickering	Right. P5-6, half M plus M2-3
P228432	Ausktribosphenidae		scrap rock	2009	L. Kool	Right. Molar talonid
P228848	*Bishops* sp.	M. Walters	ETRW, Otways	10.12.2006	D. Pickering	Left. P6, M1, partial M2
P229037	*Teinolophos trusleri*	M. Cleeland	#91	2008	D. Pickering	Right. Edentulous with alveolae for x4 molars and ultimate premolar
P229194	Mammalia	N. Barton	#770	07.03.2007	D. Pickering	Isolated upper Premolar
P229408	*Teinolophos trusleri*	M. Walters	#300	14.02.2008	D. Pickering	Left. Ultimate premolar, M1-4
P229409	Ausktribosphenidae	N. Evered	#180	07.02.2007	D. Pickering	Possibly *Bishops whitmorei* . Left. P5-6, M1-3
P229410	*Teinolophos trusleri*	C. Ennis	#90	2008	D. Pickering	Right. ?M1 plus M3
P229649	*Bishops whitmorei*	J. Tumney	#330	2009	D. Pickering	Right. P2-3,5-6, M1-3
P231328	*Bishops* ?	A. Maguire	ETRW, Otways	29.11.2009	D. Pickering	Maxilla fragment with x2 molars
P232567	*Ausktribosphenos* sp.	M. Walters & J. Wilkins	#270	26.02.2012	D. Pickering	Right. Broken premolars. M1-3
P232892	*Bishops* sp.	A. Werner		16.02.2013	D. Pickering	Left. ?M2
P252052	"Tim's tooth"	T. Ziegler	ETRW #626	20.02.2015	D. Pickering	Upper premolar
P252207	*Bishops* sp.	O. Campbell	ETRW #200	07.02.2015	D. Pickering	Posterior part of right mandible w x1 molar
P252730	*Corriebaatar marywaltersae*	W. White	Tragics day	11.11.2017	L. Kool	Left. P4
P256479	Mammalia	M. Walters	Tragics day	15.12.2019	L. Kool	Fragment with single tooth
P208090	*Ausktribosphenos* sp.	M. Lowrey	Honey Locality	21.05.2021	L. Kool	Left. M2

CRETACEOUS VERTEBRATE LOCALITIES IN GIPPSLAND

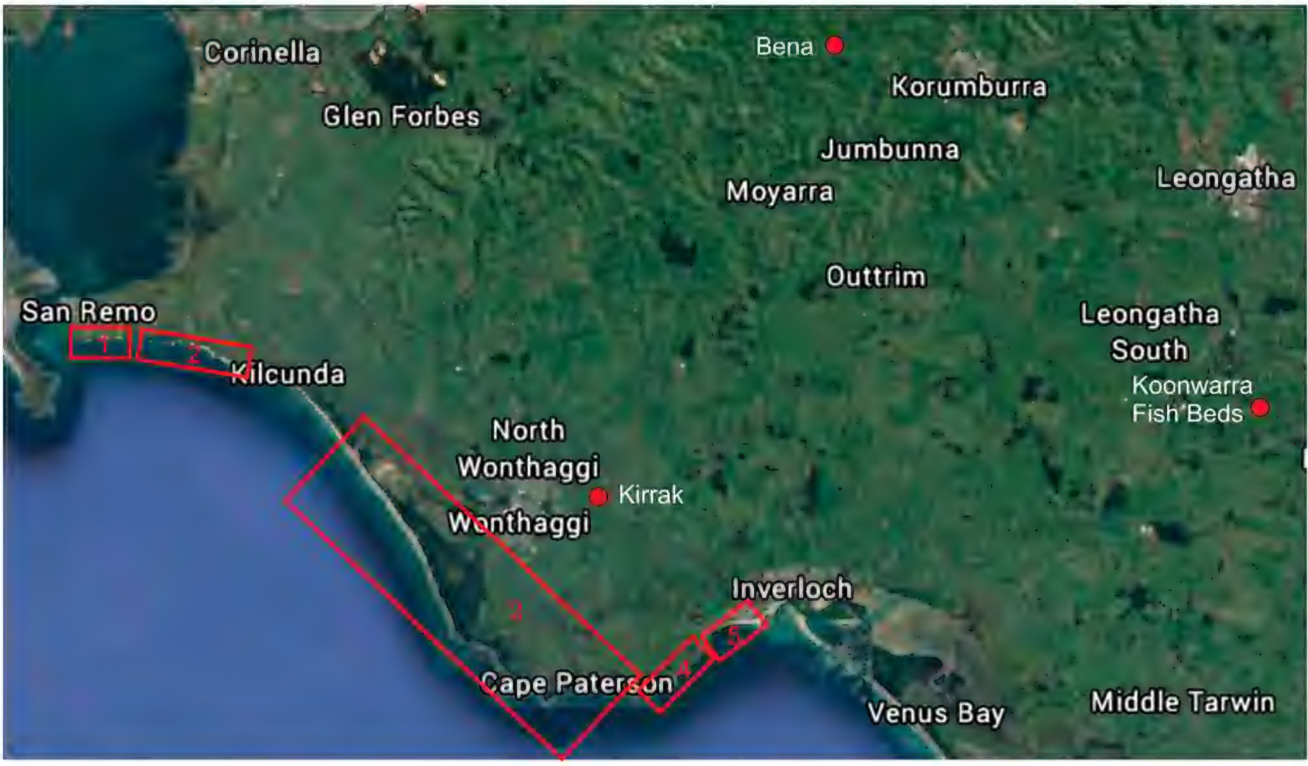
BY LESLEY KOOL AND MELISSA LOWERY



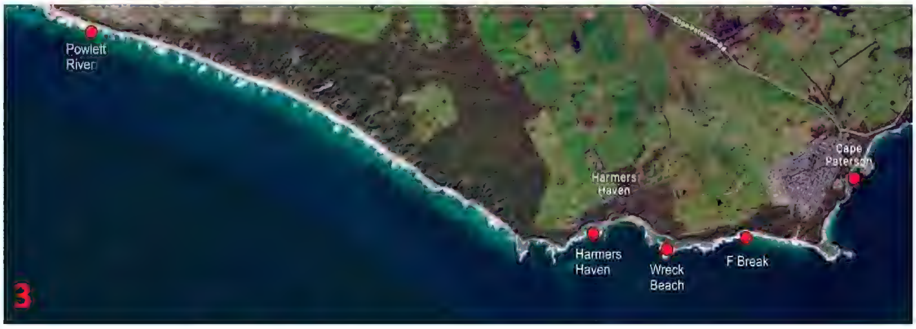


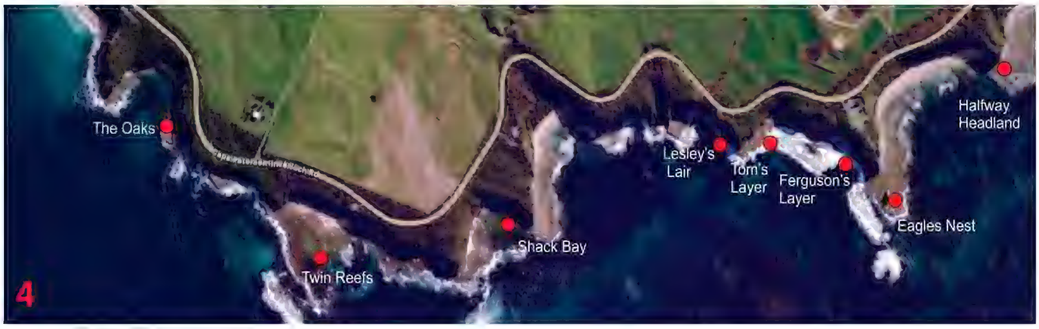
TAXA	San Remo Back Beach	Potters Hill	Rowell's Beach	Skull Cove	Punch Bowl	The Haybaler	Andrew's Beach	Orbital site	Tree Trunk Point	The Arch	Black Head	Kilcunda	Powlett River	Harmer's Haven	Wreck Beach	F Break	Cape Paterson	The Oaks	Twin Reefs	Shack Bay	Lesley's Lair	Tom's Layer	Ferguson's Layer	Eagles Nest	Halfway Headland	The Honey Locality	The Caves	Flat Rocks	Swim O'clock Rock	Ankylosaur Point	Noddyland	RACV Point	Mary Anning	Kirrak	Melissa's Mine	Bena	Koonwarra
Mammalia:																																					
Australosphenidae (Unidentified)																												■									
Ausktribosphenos nyktos																												■									
Ausktribosphenos sp.																										■		■									
Bishops whitmorei																												■									
Kryoparvus gerriti																												■									
Monotremata (Unidentified)																												■									
Teinolophos trusleri																												■									
Multituberculata (Unidentified)																																					
Corriebaatar marywaltersae																												■									
Dinosauria:																																					
Dinosauria (Unidentified)	■	■	■		■			■	■	■	■	■	■	■	■	■		■		■	■	■	■	■	■	■	■	■	■	■	■		■		■	■	
Ornithopoda (Unidentified)	■	■			■					■	■	■	■	■	■			■		■		■	■	■		■	■	■	■	■	■	■	■				
Fulgurotherium australe										■														■													
Galleonosaurus dorisae																						□					■	■		■							
Qantassaurus intrepidus																												■									
Ankylosauria										■				■														■		■			■				
Neoceratopsidae (Unidentified)																																					
Serendipaceratops arthurcclarkei										■																											
Theropoda (Unidentified)	■				■					■	■	■	■							■	□			■	■			■					■				■
Megaraptora										■													■	■				■									
Ceratosauria:Noasauridae	■																																				
Aves (birds)																												■									■
Other Vertebrates:																																					
Plesiosauria (aquatic reptiles)	■		■										■										□	■				■					■				
Pterosauria (flying reptiles)																						□		■	□			■			■						
Testudines (turtles)											■		■				■				■	■		■	■	■	■	■	■		■	■	■		■	■	
Temnospondyli (amphibians)	■	■	■	■	■	■	■	■	■							■	■																				
Koolasuchus cleelandi	■	■	■		■																								■								
Dipnoi (lungfish)	■				■							■	■							■			■	■	■			■	■	■	■			■			■
Neoceratodus nargun					■																			■				■									
Archaeoceratodus avus																								■													
Actinopterygii (ray finned fish)										■	■		■									■	■	■	■		■	■	■	■	■		■	■		■	■
Coccolepis' woodwardi																																					■
Koonwarria manifrons																																					■
Psilichthys sp.																																					■
Wadeichthys oxyops																																					■
Waldmanichthys koonwarri																																					■
Trace Fossils:																																					
Dinosaur footprints																			■					■		■		■	■			■					

Key: ■ fossil from locality identified; □ fossil from locality tentatively identified



Maps: Google Earth
Data: SIO, NOAA, US Navy, NGA, GEBCO, Landsat / Copernicus, CNES / Airbus, Terrametrics





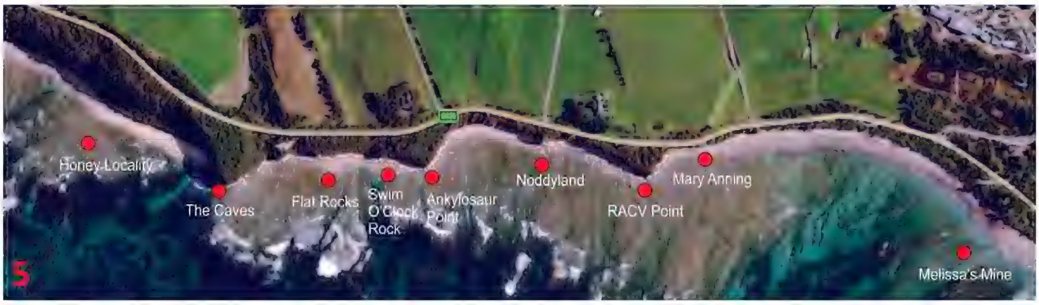


Image: supplied by M White

MAKING THE MOST OF FRAGMENTARY FOSSILS

BY MATT WHITE

Sedimentary rocks from the Mesozoic Era in Australia have produced numerous isolated (and often incomplete) bones from dinosaurs and other vertebrates, but very few associated or articulated skeletons. Numerous pre- and post-diagenesis (changes in the sediment before and after it is converted to rock) events, such as carcass exposure prior to burial, scavenging (evidenced by shed theropod teeth or bite marks), depositional processes (transportation, burial, reworking), weathering, excavation and collection all contribute to the fragmentary nature of these remains. Unfortunately, identifying isolated bones or fragmentary remains beyond high-level taxonomic ranks such as Ornithopoda or Theropoda is difficult and those identified to lower taxonomic levels are often debated. Dr Nicolás Campione and I came up with the idea of using modern 3D scanning techniques to compare these fragmentary fossils with examples of known identity to help evaluate and identify such specimens. I was motivated to do this because it always bugged me that palaeontologists rely so heavily on detailed, long-winded descriptions to try to justify the identification of specimens, despite having 3D technology that they can utilise in order to gain a quantitative (numeric) measurement of similarity.

To demonstrate this methodology, I focused on a specimen from near Kilcunda in Victoria that I examined back in 2012. It was a fragment of a large theropod finger claw (manual ungual), possibly belonging to a large megaraptorid theropod — similar to Winton's *Australovenator wintonensis*. Initially I compared the Victorian claw with the claw on the first finger of *Australovenator*, and found it to be distinctly different. However, at this stage the claw from the second finger of *Australovenator* was not known: the holotype specimen of *Australovenator* was described in 2009, before all of the elements were mechanically prepared (these were included in subsequent publications). The discovery of the claw from the second finger of Australovenator revealed an uncanny resemblance to the Victorian claw, despite the fact that the latter would have been considerably larger when complete.

The analysis required the specimens to be captured in 3D by scanning using a hand held 3D surface scanner and computed tomography (Mackay Mater Hospital). Once developed into 3D digital meshes, the specimens needed to be scaled to the same size and aligned in the same 3D space. We then had to make sure we were comparing the same surfaces, so fractures and artefacts were removed from the scans to ensure the exact surface margins of both specimens were being compared. These meshes were then digitally aligned using the software package Cloud Compare, which was also used to develop heat maps of the compared surfaces and subsequent quantitative data. Basically it enabled us to visualise the differences and similarities between the two specimens.

Through the use of this method we were able to identify that the Victorian claw was nearly identical in shape to the claw on the second finger of *Australovenator*. Given that they differed only in size, the specimens revealed stasis in megaraptoran claw morphology throughout a timespan of 10 – 15 million years.

It is my hope that anatomists and museum curators seeking quantitative support for specimen identification and comparisons may use our method in the future, especially in Australia where so many vertebrate fossils are incomplete bones.

Reference

White M. A., Campione N. E., 2021, A three-dimensional approach to visualize pairwise morphological variation and its application to fragmentary palaeontological specimens. *PeerJ* 9:e10545

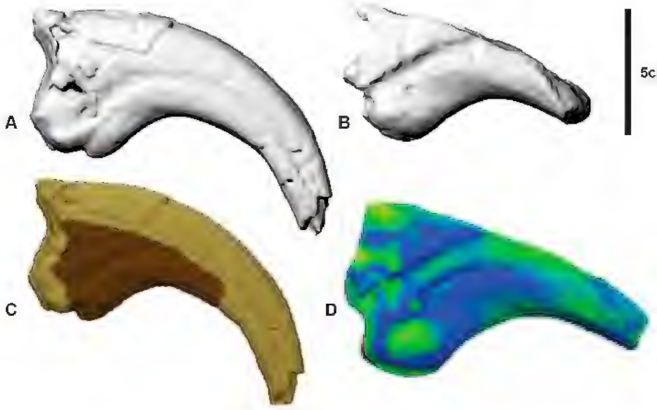


Image: M White

Manual ungual II-3 of Australovenator wintonensis *AODF604 and NMV P186153. A)* Australovenator wintonensis *AODF604; B) NMV P186153; C) scaled AODF604 and NMV P186153; D) heat map displaying variation between the 2 specimens.*

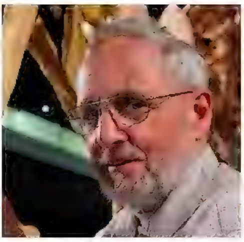


Image: Museums Victoria

WHY DID ALL THESE DINO FOOTPRINTS SUDDENLY APPEAR?

BY TOM RICH

Until about two years ago, two dinosaur footprints were known from the Bass Coast. Now there are about 145 known. How did this come about? The brief answer is that Melissa Lowery acquired the mindset that enabled her to recognise these ichnites (as they are properly called). No one else had done so.

In 1972, Edmund Gill, then palaeontologist at the National Museum of Victoria, wrote an article explaining why, other than the single theropod toe bone found by William Hamilton Ferguson in 1903, dinosaurs were unknown from the Cretaceous rocks of Victoria. Regarding Ferguson's specimen as a rare fluke, he made a quite plausible case that otherwise dinosaurs were unknown from Victoria. He pointed out that, by then, European geologists had, for more than a century, been familiar with the Victorian Cretaceous outcrops and no other dinosaurs had been found.

Six years after Gill's paper was published, the geologist Rob Glenie took cousins John Long and Tim Flannery to the site where Ferguson's specimen was found. On that initial visit, John found a pebble in a rock pool with a fossil bone in it. That made it quite clear that Ferguson's discovery was not a fluke and gave an idea of what a fossil bone in those rocks looked like. With that mindset, over the next six months, Tim explored the coastal outcrops between Inverloch and San Remo and found another thirty fossil bones, several of which were clearly those of dinosaurs. From this initial effort by Tim Flannery has flowed all the subsequent searches for additional dinosaurs on the Victorian coast and the excavations that followed.

Image: S Madder

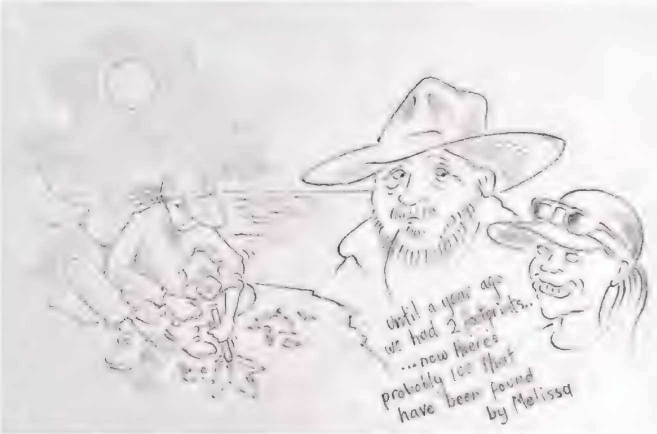


Image: S Madder

In a like manner, Melissa Lowery acquired the mindset to recognise ichnites that no one else had previously done during the four decades that the Dinosaur Dreamers had been working along the Bass Coast. She began prospecting along with Mike Cleeland. She soon was finding much smaller fossil bones than the usual prospecting discoveries.

There are literally hundreds of distinct bands of rock crossing the shore platform near Inverloch. They are oriented roughly perpendicular to the shoreline and typically dip to the north. Some are conglomeratic sands with numerous pebbles in them. Others are typically finer grained rocks formed exclusively of sandstone and mudstone. Melissa began her search by following individual bands from near the cliffs towards the edge of the sea. In doing so, she identified particular bands as having a great potential to produce fossil bones, particularly the smaller ones which were her forte. These particular bands she kept in mind for future visits.

One day after searching for fossil bones, she was heading towards home. In doing so, she happened to follow a sandstone-mudstone layer towards her departure point from the beach. Even though this type of layer was not likely to produce bones, she kept her eyes on it as she walked along. The angle of the sun at that time revealed an image of a track to her. Nearby were other tracks. She documented these with a mobile phone camera and shared them with Mike Cleeland (who was not far away) and Lesley Kool. Both replied enthusiastically that, yes, Melissa had found dinosaur tracks.

Following up on this, Melissa began systematically searching the sandstone-mudstone layers for additional tracks. And once this approach was taken, the results have added a significant component to our knowledge of the Bass Coast dinosaurs. Until now, no one was aware that these ichnites were there to be found.

Image: W White

WHAT IN THE EAGLES NEST SANDSTONE IS THAT?

BY ALAN TAIT

As dinosaur dreamers, we are all used to the story of the origin of our fossiliferous rocks in the Victorian Lower Cretaceous. We know about the river channel sandstones with mudstone clasts and plant fragments and animal fossils, and the interbedded floodplain sediments with soils and lakes and footprints and peat (now coal). But every now and then an extra detail emerges to add to this general picture of the conditions in the rift valley formed as Australia and Antarctica broke apart.

The sandstone that forms the cliffs and shore platform at Eagles Nest, midway along the Cape Paterson to Inverloch foreshore, contains layers of interesting-looking clasts (Fig. 1). These are cemented mudstone cylinders up to a few centimetres long and up to one centimetre in diameter. Most show an axial tube of up to one millimetre in diameter and often filled with sand, and some show laminations at right angles to the axial tube. A clue to the origin of the clasts is that some contain, instead of an axial tube, a U-shaped tube (Fig. 2) which immediately suggests a worm burrow. The axial tubes in the cylindrical clasts are either single vertical burrows or separated parts of U-shaped burrows.

An example of vertical burrows is shown in Figure 3A from mudstones under the fossil-bearing channel sandstone at Slippery Rocks at Dinosaur Cove. These burrowed mudstones contain layers of wind-wave-rippled sandstone with footprints, indicating deposition in a shallow lake on a floodplain. And although there is no cementation around the Slippery Rocks burrows, Figure 3B shows what they would look like with a cemented coating of mudstone.

Thus, the unusual clasts in the Eagles Nest sandstone started off as worm burrows in the mud on the bottom of a shallow lake on the floodplain of a large river which flowed westward along the Australia-Antarctica rift valley. The worms secreted slime to line the walls of their burrows in the soft mud to prevent them from collapsing. When the worms died, they and the organic slime lining the burrows degraded by bacterial action, causing the cementation of the mud around the burrows.

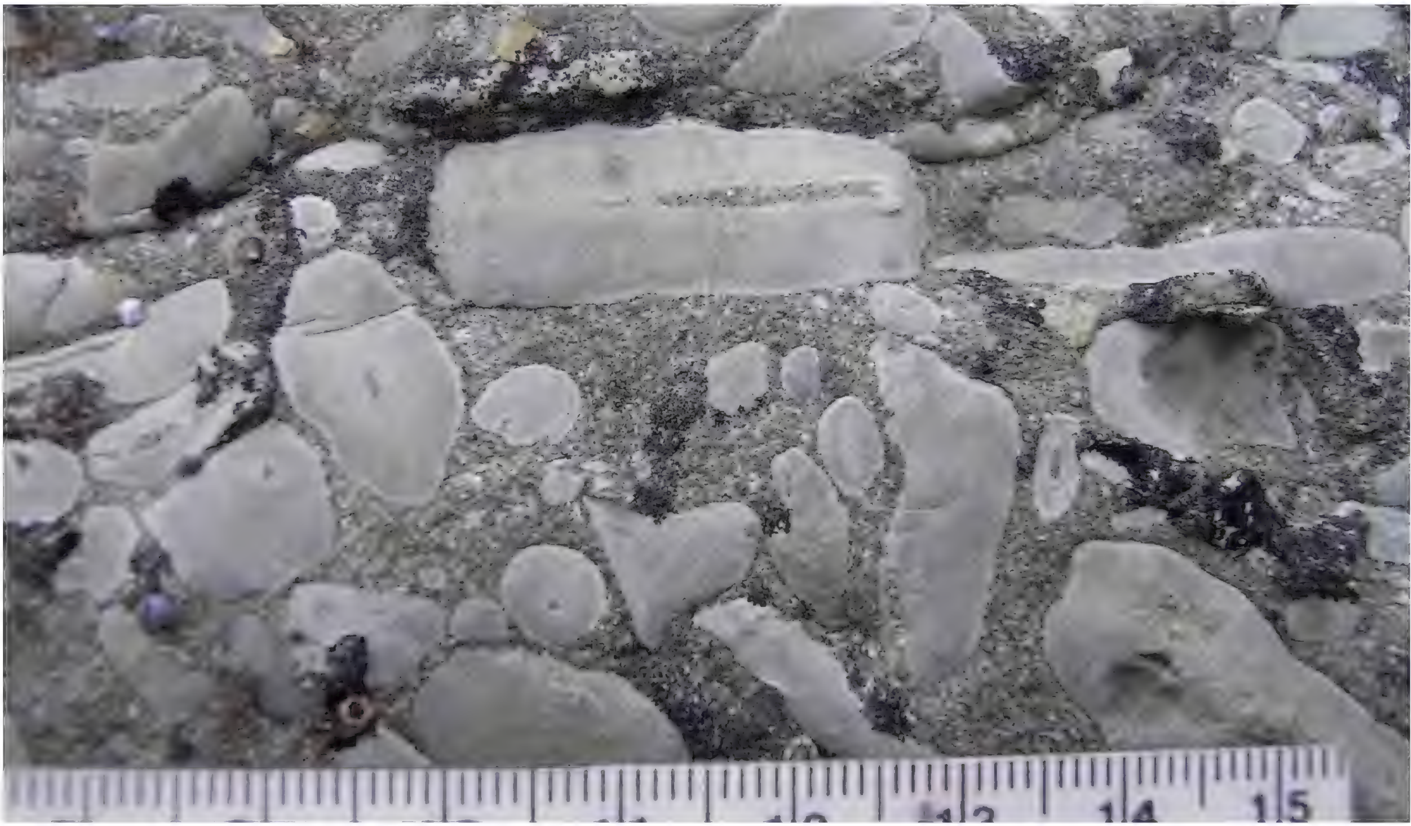
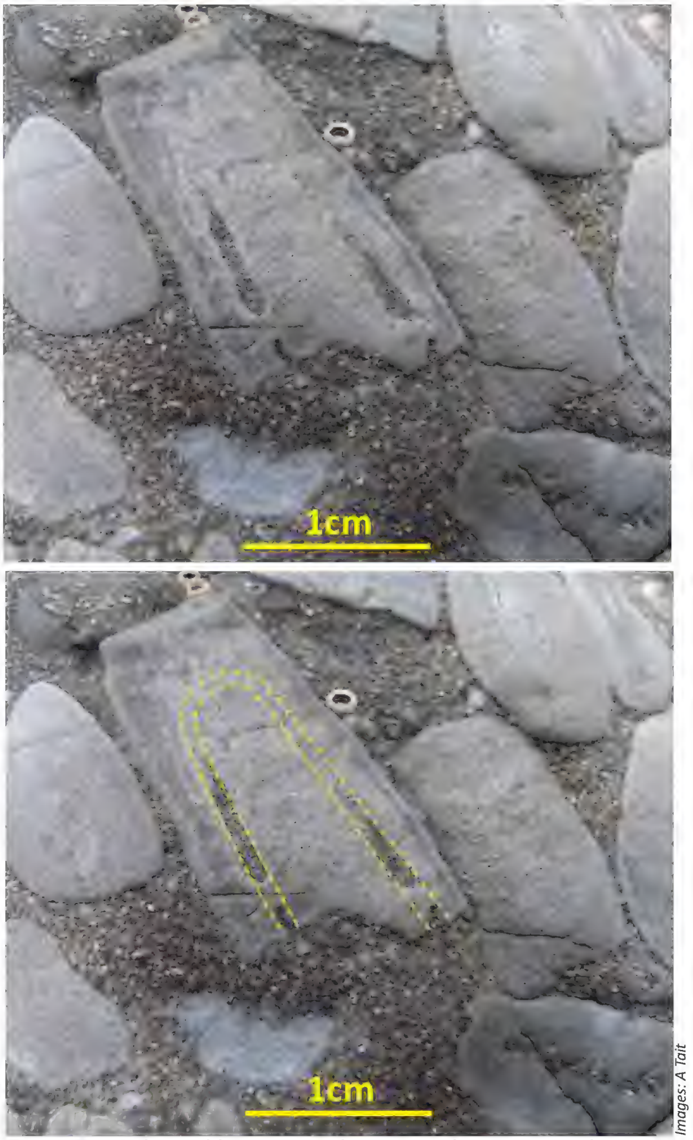


Image: A Tait

Figure 1. Unusual clasts in the Eagles Nest sandstone (scale in centimetres).

After a few tens of thousands of years, the buried lake sediments with the cemented burrows were eroded by the lateral migration of the deep meandering river which deposited the Eagles Nest sandstone. The turbulent currents in the river disintegrated the mud between the cemented burrows and they became clasts to be transported by the river and deposited downstream to what is now known as Eagles Nest.

These transported burrows are an example of intraclasts which are clasts derived from locally deposited sediments within the rift valley, as opposed to extraclasts which have been derived from older rocks outside the valley. Intraclasts in a river channel sandstone give information on coexisting depositional environments, such as the various mudstone clasts which come from contemporary floodplain soils, laminated sandstone/mudstone clasts which come from overbank sediments or low-stage drapes within the river channel, and the transported burrows from a shallow floodplain lake which are the subject of this article. And plant fragments and bones in a river channel sandstone can be regarded as intraclasts which give us information about the flora and fauna of the alluvial valley.



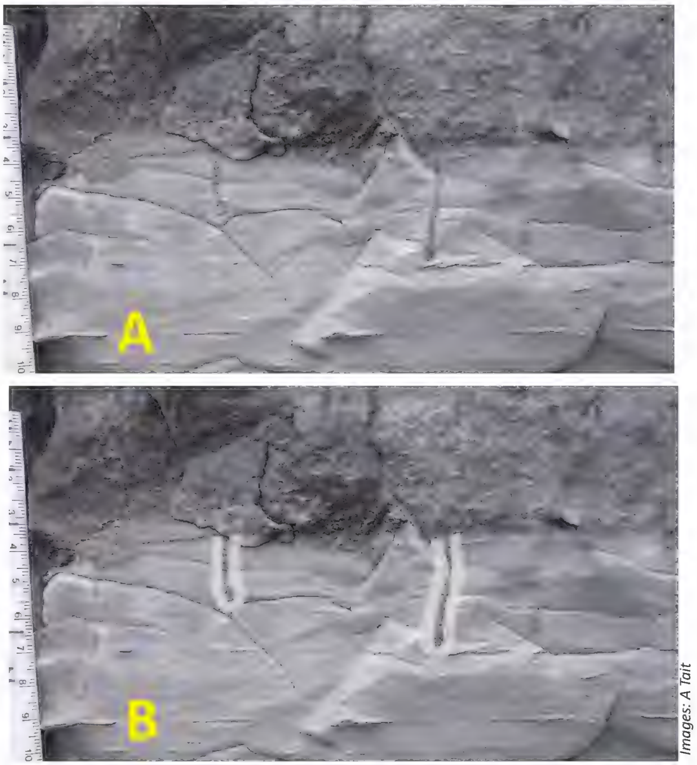
Images: A Tait

Figure 2. U-shaped burrow in clast in Eagles Nest sandstone.

The presence of such unusual clasts as transported burrows can be used for correlation of the sand bodies that contain them. Transported burrows occur not only in the Eagles Nest sandstone but also in the sandstone to the west at Lesley's Lair, indicating that these are the same sand body and that the fault between the two localities has only a small displacement.

The ability to use an example of sediment at Dinosaur Cove in the Otway Basin to illustrate the solution to a problem at Eagles Nest in the Gippsland Basin despite their 13 million year age gap and approximately 200 kilometre distance apart, is an example of the long term and widespread persistence of the Victorian Early Cretaceous fluvial depositional environment.

Incidentally, transported burrows occur in shallow marine environments too, cemented after their occupant's death and later eroded by storm waves and deposited as layers of clasts, some still hollow.



Images: A Tait

Figure 3. A. Sand-filled vertical burrows in shallow lake mudstone at Slippery Rocks at Dinosaur Cove. B. As A, with cementation zones drawn around two sand-filled burrows to show how clasts in Eagles Nest sandstone formed.

Image: L Nink

2021: THE WATER WELL-TRODDEN

BY RUAIRIDH DUNCAN

In lieu of a major dig once again this year, I consider myself very fortunate to have been able to participate in one of the collecting weekends undertaken by some intrepid Dinosaur Dreaming volunteers in February. Sadly, I only got to attend the one, as subsequent weekends were twice scheduled mere days before several deadlines came due. Overall, 2021 has been something of a slow year for me, much like its predecessor, but I remain hopeful that we're not far off being able to return to the Victorian coast in search of buried treasure in 2022! One small bright spark from this year was that I got to contribute in my own small way to the ever-evolving picture we have of the polar regions of the Southern hemisphere in the late Early Cretaceous. My first lead-authored paper (Duncan *et al.*, 2021) — which I wrote about previously whilst the research was ongoing in the 2019 Field Report — was finally published in the *Journal of Vertebrate Palaeontology* this July.

To briefly summarise it in its completed form: my Honours project in 2019 was concerned with the first cranial specimens from ornithopods of the Eric the Red West (ETRW) fossil site. This site has so far produced some of the most noteworthy Victorian finds of recent years such as: theropods (including a claw which is near-identical to *Australovenator*); the only definitive evidence of an Australian elaphrosaur; Cretaceous mammals; pterosaurs; and a whole host of aquatic organisms. However, significantly for me, there was only one ornithopod named for the site: the magnificent tail and hindlimb of *Diluvicursor*.

After days, weeks and months of learning ornithopod systematics, how to prepare and manipulate MicroCT data, how to make half-decent figures and how to generate a phylogenetic analysis (with extremely limited success), I arrived at my mostly completed project in late 2019. In mid 2020 I devoted several, several weeks to the task of turning an Honours project into a scientific paper, a process involving significant rewrites, remaking every figure, and throwing in occasional new additions. Doing so during a pandemic was greatly assisted by the use of my housemate's 3D printer, as seeing the specimens in real life was, and remains, very much out of the question. By the end of the year, it was finally in a submissible state. A mere six months and two revisions later, it was, at last, published.

Thus a rundown seems in order. Much to my glee, I found I had something new to add to each of the three ornithopods known from upper jaws in Victoria, *Atlascopcosaurus*, *Leaellynasaura* and *Galleonosaurus*. The first, *Atlascopcosaurus*, has had three partial maxillary (upper jaw) specimens definitively referred to it. All of these were described in 1989. The *Atlascopcosaurus* maxilla from ETRW is the fourth we can add to this list, and the first new addition in 22 years! It's also the most complete specimen of this dinosaur ever described despite being merely a mostly complete maxilla, but we now at least know roughly how many teeth they had! *Leaellynasaura*, the most famous of Victoria's ornithopods and currently (at the time of writing) in the running to become the Victorian state fossil emblem, was also known from surprisingly few specimens with only the holotypic maxilla being directly comparable to the ETRW specimens. However the holotype has, since its initial description, been thought to be a juvenile due to several developmental markers such as the large eye sockets, small size and a low number of teeth. With the ETRW jaws, I was able to prove that this was indeed the case, as I described the first adult specimen referred to *Leaellynasaura*, further adding to the evidence which suggests that multiple types of high-latitude dinosaurs were, despite the extreme polar seasonality, able to make a living year-round in these regions, very much unlike the high-latitude fauna of today, most of which very rarely stays in the region for longer than the polar summer. In fact, some animals, such as caribou, reach 50 – 70% of their adult size in their first year, such are the distances they need to travel to visit and vacate the polar regions year-on-year.

Both of the aforementioned dinosaurs were found in the Eumeralla Formation, whereas the other two ornithopods known from skull material in Victoria, *Qantassaurus* and *Galleonosaurus*, are known from older sediments in the Upper Strzelecki Group. With that knowledge, it was something of a surprise when two of the ETRW specimens I studied were nigh on indistinguishable from *Galleonosaurus*, despite being found over 12 – 17 million years removed from the holotype. This meant, quite surprisingly, that there seems to have been as many as three different ornithopods all living alongside one another during the deposition of the ETRW site. Furthermore, the discovery of cf. *Galleonosaurus* (the name given to the ETRW specimens) in the Eumeralla Formation is not completely without precedent. In 2019, Matt Herne described an Upper Strzelecki Group maxilla and a Eumeralla Formation tooth and assigned them to cf. *Atlascopcosaurus* and cf. *Qantassaurus*, respectively. Both of these, like cf. *Galleonosaurus* are also on the opposite sides of the Victorian Cretaceous to where we would expect to find them. Interestingly, they noted that cf. *Atlascopcosaurus* appeared to be in some way intermediate in its morphology between *Atlascopcosaurus* and *Galleonosaurus*, possibly indicating a recent evolutionary split. Therefore, it would appear that whilst the environment around them was far from static, with changes to the floral community and a steadily increasing temperature, the different genera of ornithopods that called Victoria home weren't under too much evolutionary pressure to change. Indeed, the seemingly minor degree of morphological disparity between the older specimens of *Galleonosaurus* and cf. *Atlascopcosaurus* from Flat Rocks relative to the younger specimens of cf. *Galleonosaurus* and *Atlascopcosaurus* from ETRW could perhaps indicate that, along with the appearance of *Leaellynasaura*, the Victorian Cretaceous was creating opportunities for ornithopods to diversify as time went on. That speculation does, of course, come with a big old asterisk next to it. Particularly as one of the defining characteristics of our fossil record is just how fragmentary and incomplete several of our specimens often are, with *Leaellynasaura*, *Galleonosaurus*, *Atlascopcosaurus* and *Qantassaurus* being known from little more than skull fragments with no associated post-crania. It's this lack of morphological overlap between the four cranial genera that leads us back to discussing *Diluvicursor*.

Whilst this research does not rule out *Diluvicursor* as a genus in its own right, it might cast some doubt on it. There are thought to be two to three distinct post-cranial skeleton types in Victoria. Of these, only *Diluvicursor* has been named. However, its lack of overlap with the holotypes of the four other taxa means that direct comparison (until such time as we find a skeleton which unambiguously associates an ornithopod head and hindlimb) is not possible. Nonetheless, it seems unlikely that the jawbones described from Eric the Red West contain a fourth as yet undescribed maxilla type attributable to *Diluvicursor*. Even so, until such time as we can prove this, it remains merely a suggestion. Like many things in palaeontology, more data will be needed.

This about sums up the extent of my paper and a good few months of my pandemic! I also drew some rather dinofuzzy versions of each of the ETRW ornithopods in profile (back cover), wrote a press release and talked about dinosaurs on off-peak radio, which was a new experience. Finally, as with my Honours year, I had plenty of help from my former supervisor and all-around good dude, Steve Poropat, as well as my housemates and my friends, who spent far too long slashing away at my clumsy sentence structure and made most of what I wrote down seem strangely legible.

As to my future, I'll be starting my PhD in October with a much younger group more closely related to ourselves: the cetaceans of the Palaeogene North Pacific, a group which, much like the ornithopods of Victoria, were greatly influenced through the course of their evolution by being in the polar regions, in particular, the relatively recent (geologically speaking) glaciation of the Northern and Southern Hemisphere, which reduced global sea levels greatly. This shrank the available shallow, coastal marine environments found along continental shelves and created the circumstances for baleen whales to begin to reach vast body sizes and for the forerunners of modern oceanic dolphins to diversify and thrive. I hope to learn how the ancestors of these modern cetacean groups were influenced by their environments to become the creatures they are today.

But boy howdy, there sure remains a lot to learn.

Reference:

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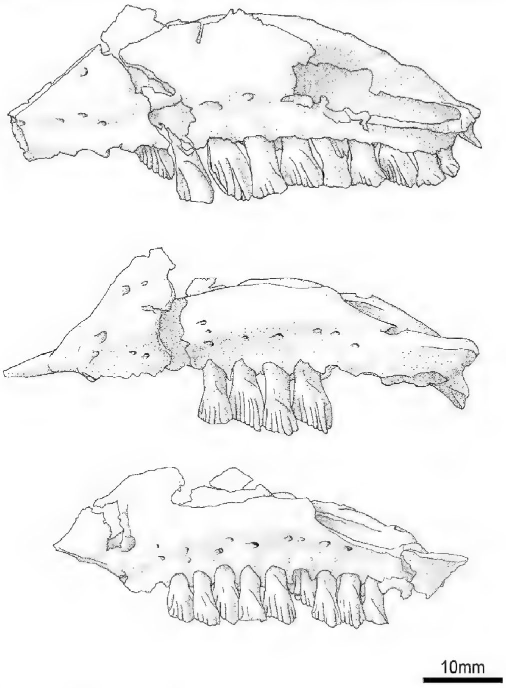


Image: R Duncan

ETRW ornithopod maxillae

Image: W White

THESE ARE THE OIDS (IDS & INES) THAT YOU'RE LOOKING FOR

BY STEPHEN POROPAT

Dinosaur names can be confusing; particularly the names that refer to groups of dinosaurs. In 2020, an elaphrosaurine was reported from Eric the Red West. The year before that, megaraptorid remains were described from the same site. And in 2018, Timimus — which was originally described as an ornithomimosaur — was interpreted as a tyrannosauroid.

All these suffixes! -ine, -id, -oid… what do they all mean? Well, the short answer is: not as much as they used to. Recognising that that is not particularly helpful, here's the long answer: each of these suffixes was meant to correspond to a rank within Linnaean biological taxonomy.

If you ever studied Biology in school, you were probably taught about the hierarchy of classification proposed by Swedish botanist Carolus Linnaeus in the 18th Century. If that's not ringing any bells, these words might: Kingdom, Phylum, Class, Order, Family, Genus, Species. Linnaeus developed his *Systema Naturae* in 1758 to classify as many life forms on Earth as he could. He proposed that each distinct life form should be given a two-part scientific name — comprising a genus name (more inclusive than a species name, can accommodate multiple species) and a species name (less inclusive than a genus name). To this day, this remains standard practice in biology and palaeontology, although many species are now regarded to include 'subspecies' or 'races'. Outside academia, most dinosaurs are referred to only by their genus names, like *Leaellynasaura* and *Atlascopcosaurus*. But each of these has a species name too: *amicagraphica* for *Leaellynasaura*, and *loadsi* for *Atlascopcosaurus*.

In Linnaeus's system, *Leaellynasaura* and *Atlascopcosaurus* would also be assigned to higher ranks — a Family ('Hypsilophodontidae', back in the day), Order (Ornithopoda), Class (Reptilia), Phylum (Chordata), and Kingdom (Animalia), with many sublevels in between. Indeed, they do still belong to these groups. The thing is, the ranks of those groups are not necessarily what they once were. I like to picture each rank as an umbrella, simultaneously sheltered beneath a succession of increasingly large (and therefore more inclusive) umbrellas, and sheltering a cluster of nested umbrellas.

Once upon a time, different suffixes were created to apply to several ranks either side of Family:

- Superfamily (between Suborder and Family): suffix -oidea (for example Tyrannosauroidea, for tyrannosauroids);
- Family: suffix -idae (for example Megaraptoridae for megaraptorids); and
- Subfamily (between Family and Genus): suffix -inae (for example Elaphrosaurinae for elaphrosaurines).

Subfamilies are nested within families (submarines are under the ocean), and families are nested within superfamilies (Superman flies over the world, or would if he wasn't fictional).

If my meaning is unclear, let's look at an example. *Tyrannosaurus rex* is a member of the 'subfamily' Tyrannosaurinae, which is part of the Family Tyrannosauridae, which is part of the 'superfamily' Tyrannosauroidea. This means that *Tyrannosaurus rex* is a tyrannosaurine tyrannosaurid tyrannosauroid. Depending on the context, a palaeontologist could talk about *Tyrannosaurus rex* as a tyrannosaurine, a tyrannosaurid, or a tyrannosauroid. However, not all members of the group Tyrannosauroidea are also part of Tyrannosauridae, let alone Tyrannosaurinae. For example, *Timimus hermani* (from Dinosaur Cove) is a tyrannosauroid, but not a tyrannosaurine or a tyrannosaurid. This means that it is not as closely related to *Tyrannosaurus rex* as, say, *Tarbosaurus* or *Daspletosaurus* (both of which are tyrannosaurines), or *Albertosaurus* and *Gorgosaurus* (which are both tyrannosaurids, but not tyrannosaurines — they're albertosaurines).

Perhaps a modern example would help too. The genus *Panthera* (no, not the heavy metal band) includes the tiger (*P. tigris*), lion (*P. leo*), leopard (*P. pardus*), jaguar (*P. onca*) and snow leopard (*P. uncia*). Together with the genus *Neofelis* (clouded leopards), the genus *Panthera* is part of the 'subfamily' Pantherinae — the big cats. Pantherinae is part of the Family Felidae — the cat family, which also includes your pet cat (*Felis catus*) and such adorable fluffballs as the serval (*Leptailurus serval*), ocelot (*Leopardus pardalis*) and caracal (*Caracal caracal* — I swear I did not make that up). Sadly, your cat does not belong to Pantherinae (unless you're Joe Exotic or one of his affiliates), but it does still belong to Felidae — specifically, within a different 'subfamily' called Felinae. Felidae belongs to a more inclusive group (once regarded as a 'superfamily') called Feloidea. This group includes all members of Felidae, as well as their closest relatives: the linsangs of Southeast Asia (if you don't know what they are, look them up. You're welcome). Finally, Feloidea belongs to the group Feliformia (once regarded as a 'suborder'), which includes less cat-like cat relatives: mongooses (not mongeese); hyenas (they are closer to cats than dogs, despite appearances); and viverrids — all belonging to the 'superfamily' Viverroidea. What this means is that a tiger is a pantherine felid feloid feliform, and your cat is a feline felid feloid feliform. A spotted hyena (*Crocuta Crocuta*), by contrast, is a hyaenine hyaenid viverroid feliform.

Phew! That was a lot to take in. Now let me tell you why the rank-based part is now largely superfluous.

The problem with biological 'ranks' is that we now know that few, if any, are truly equivalent. When Linnaeus devised his system, Charles Darwin's father had not even been born. Fossils were still oddities of uncertain origin (a great account of which can be found in Herbert Wendt's Before the Deluge [1968]). Separating birds (as Class Aves) and reptiles (as Class Reptilia) seemed completely reasonable in Linnaeus' time: no intermediates between them were known, and birds were clearly distinct from other animals. However, while it has been known for almost two centuries that dinosaurs are reptiles (Class Reptilia), it is only more recently (momentum built in the late 1960s and 1970s, but consensus was only really reached in the 1990s) that the dinosaurian ancestry of birds (Class Aves) has been widely accepted. This poses a conundrum: a class within a class! Class Aves is now by definition a part of Class Reptilia, lodged within the Order Theropoda, the suborder Coelurosauria, the superfamily Deinonychosauria, and so on… the ranks are not equivalent.

Although we now recognise that families and subfamilies don't really work in Biology, the naming system is still largely intact in many groups — particularly those for which evolutionary relationships were well established before the 1990s. In these, -ines are usually umbrellaed by -ids, which in turn are usually umbrellaed by -oids. However, the exceptions to this rule are becoming greater in number each year (notably in Dinosauria), and most new names are being developed without a specific rank in mind. As an example, earlier this year I and several colleagues named a new group of sauropods. The name we chose was Diamantinasauria —the genus name *Diamantinasaurus* with the -us lopped off and -ia tacked on. The suffix of Diamantinasauria could almost be called generic — it is rankless. It's not an -oidea or -idae or -inae because we don't regard this group as a Family, or subfamily, or any other rank. It is simply a small, exclusive clade (a biological group of any rank that only includes all descendants of a specific common ancestor) within the more inclusive clade Titanosauria, which is itself within the more inclusive dinosaurian clade Sauropoda.

So next time you're getting your -ids and -oids mixed up, don't fret — find a well-labelled family tree for whatever group you're pondering, and let the branches guide you home.

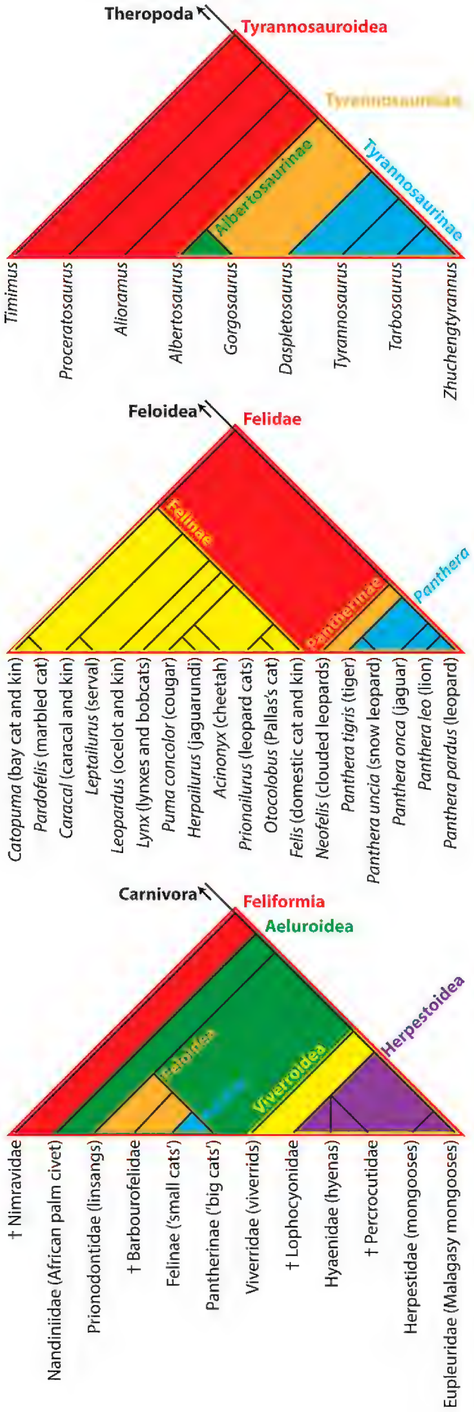
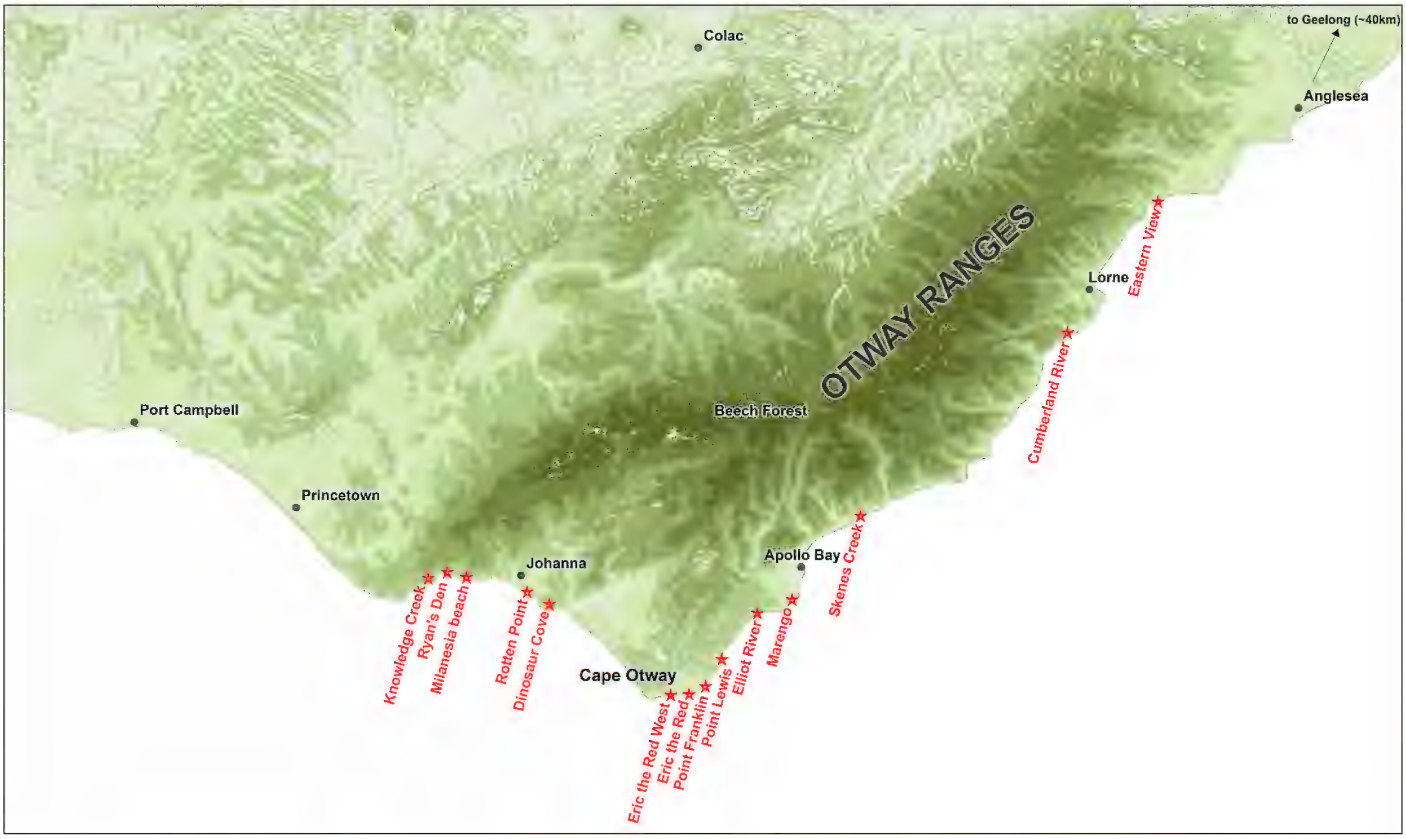


Image: S Poropat

CRETACEOUS VERTEBRATE LOCALITIES IN THE OTWAYS



TAXA	Knowledge Creek	Ryan's Den	Milanesia Beach	Rotten Point	Dinosaur Cove	Eric the Red West	Eric the Red	Point Franklin	Point Lewis	Elliott River	Marengo	Skenes Creek	Cumberland River	Eastern View
Mammalia:														
Australosphenidae (Unidentified)						X								
Bishops sp.						X								
Monotremata (Unidentified)						X								
Kryoryctes cadburyi					X									
Dinosauria:														
Dinosauria (Unidentified)		X		X	X	X	X	X	X	X	X			X
Ornithopoda (Unidentified)		X		X	X	X		X	X	X	X			
Atlascopcosaurus loadsi					X				X					
Diluvicursor pickeringi						X								
Fulgurotherium australe					X									
Leaellynasaura amicagraphica					X									
Ankylosauria (Unidentified)					X									
Neoceratopsia (Unidentified)					X									
Theropoda (Unidentified)					X	X		X						
Tyrannosauroidea					X									
Timimus hermani					X									
Megaraptora					X	X								
Ceratosauria:Elaphrosaurinae						X								
Other Vertebrates:														
Plesiosauria (aquatic reptiles)					X	X							X	
Crocodyliformes (crocodiles)					X									
Pterosauria (flying reptiles)					X	X								
Testudines (turtles)		X			X	X	X	X	X					
Otwayemys cunicularius					X									
Dipnoi (lungfish)					X	X			X					
Neoceratodus nargun					X				X					
Actinopterygii (ray finned fish)					X	X								
Trace Fossils:														
Dinosaur footprints	X		X		X							X		
Bird footprints					X							X		
Dinosaur burrows	X													

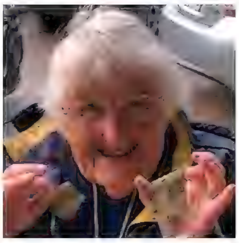


Image: W White

KOONWARRA ROCKS!

Image: W White

BY NICOLE EVERED

ILLUSTRATED BY SHARYN MADDER

In April, on a chilly day
Us diggers went down Fish Creek way,
To break the rocks in Gary's shed
About six tonnes or so, he said.

Something special is what we long for
Find at least one, but hope there's more.
Competition is very strong
But this is where we all belong.

Each chose our favourite piece of rock
From the Koonwarra fossil stock.
Plants, fish and oddments could be found
In stones selected from the mound.

Cries of joy, something's been revealed
The finder's joy is unconcealed.
As one small rock is broken open
"Is this blob good?" We are not certain.

"Are those legs? Could it be insect?"
We need an expert to inspect.
So to The Boffin it was sent
Where close inspection time was spent.

It's a COCKROACH !! – an Order known
I got the message on my phone.
One two five million years its age...
Result: the cartoons on this page!

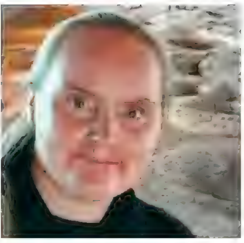


Image: A. Craig

THE WINTON DYNAMIC DESTINATION OPENS

BY LISA NINK

I remember first arriving at Karoola Station, northwest of Winton, and gazing at the Snake Creek Tracksite over a barbed wire fence (built to keep out inquisitive would-be-palaeontologist cattle). Even in the vastness of the Queensland outback, it was impossible not to be awestruck by the enormity of the footprints left by giant sauropods strolling along a floodplain 95 million years ago. Just as awe-inspiring was the scale of the task to excavate and relocate them.

The Australian Age of Dinosaurs Natural History Museum (AAOD) and Dinosaur Dreaming crews worked for two weeks to survey the site, and to plaster-jacket and excavate the most vulnerable sections of the trackways. But it would take AAOD staff and volunteers (including a few more Dinosaur Dreamers) another two and a half years to complete the relocation, and faithfully restore the entire tracksite at its new home in the March of the Titanosaurs exhibition at the AAOD Jump-Up.

In addition to the March of the Titanosaurs, the AAOD team also spent the last couple of years constructing another part of the Dynamic Destination project, the Gondwana Stars Observatory. The observatory has walls made from jet-black rendered concrete, that has been hand-moulded to resemble the surface of a meteorite, and the whole structure is encircled by mounded earth resembling ejecta from an impact crater.

On Saturday 8th May 2021, Amber Craig, Wendy White and I had the honour of joining AAOD staff and volunteers, locals, and people from across Australia to celebrate the grand opening of the Dynamic Destination Project. The day began with the official speeches, which were followed by a beautiful performance of Waltzing Matilda by two young locals. Finally, the moment we'd all been waiting for arrived, and we all watched with anticipation as AAOD Executive Chairman, David Elliot, and Queensland Minister for Tourism, the Honourable Stirling Hinchcliffe, cut the red ribbon and officially declared the exhibition open.

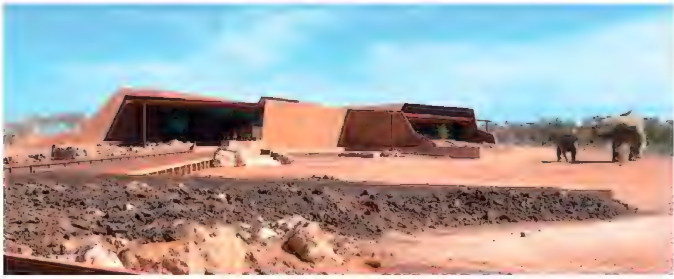


Image: L Nink

March of the Titanosaurs

Image: L Nink

Dinner under the stars on the Jump-Up

The official celebration dinner was held outdoors on the Jump-Up, complete with tables decked out with white linen cloths and fairy-light centrepieces. Each guest received a unique hand sculpted dinosaur footprint or star made by the talented Trish (Tricky) Sloan, Tourism Manager at the AAOD. They were made from welding rods left over from the assembly of bronze dinosaur statues for the new exhibition, and they doubled as door prize entries with one unique shape the winning 'ticket'. The wonderful AAOD staff and volunteers gave up their time to help with everything from running the bar to clearing away dishes, and ensuring each table was supplied with special edition dinosaur trackway wine.

Following the opening speeches, we were treated to a performance by local celebrities, the Crack-Up Sisters. Dressed head to toe in their sparkly cowgirl clobber, S. T. Ruth and Rowdy entertained us with their humour, acrobatic and whip cracking skills, and even hosted a palaeo-themed quiz. They also helped run the auction where the sale of AAOD memorabilia, local artists' creations and other donated items raised thousands of dollars for the AAOD Museum. David Elliott closed

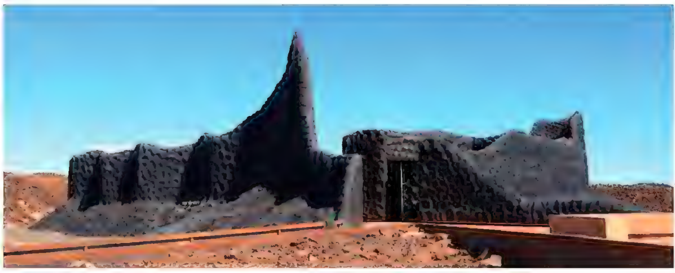


Image: L Nink

Gondwana Stars Observatory

the evening by thanking everyone involved in bringing the Dynamic Destination project together, including Mike and Patrice Elliot, the owners of Karoola Station who donated the tracksite to the AAOD, and the Dinosaur Dreaming crew for our help. It was a great night!

But, the undoubted highlight was getting to see the spectacular new March of the Titanosaurs Exhibition. Walking up the boardwalk to the exhibition building you pass two life-size (and life-like) bronze titanosaurs, one a 10 metre long juvenile and the other a colossal 17 metre long adult. At the entrance you're greeted by a trio of cheeky little theropods and a pair of graceful ornithopods also made of bronze, before you walk through a large tinted glass door into a cavernous hall. Once your eyes adjust from leaving the bright Winton sunshine, you see stretching out before you the 54-metre-long, 12-metre-wide Snake Creek Tracksite. The tracks look just as they did back on Karoola Station, but they are now shielded from the elements in temperature controlled and weatherproof accommodation.

All fossils are amazing and teach us about the history of life on Earth, but the wonderful thing about a footprint is that it is a direct connection to a single moment in that history. A moment when a living, breathing animal was interacting with its environment and the other creatures it shared that environment with.

The Snake Creek Tracksite provides a glimpse of life in the Winton region 95 million years ago. The sauropod tracks with their concentric rings formed as the giant animal's foot pressed down and broke the surface of an exposed floodplain. Tracks of ornithopod and theropod dinosaurs ranging from chicken-sized, to as big as *Australovenator wintonensis* later walked through shallow waters that covered the same floodplain. There are even traces of aquatic animals including underwater-walking tracks of crocodiles, probable turtle tracks and feeding traces likely attributable to lungfish.

Image: L Nink

David Elliot and Stirling Hinchcliffe cut the red ribbon

Image: L Nink

Dinosaur Dreamers play with the titanosaur statues

It was a great privilege for Dinosaur Dreaming to have played a small part in preserving this important piece of Australia's natural history. We thank David and Judy Elliot, the AAOD and Mike and Patrice Elliot, owners of Karoola Station for the opportunity.

For more information or to visit AAOD, explore their website https://www.australianageofdinosaurs.com.

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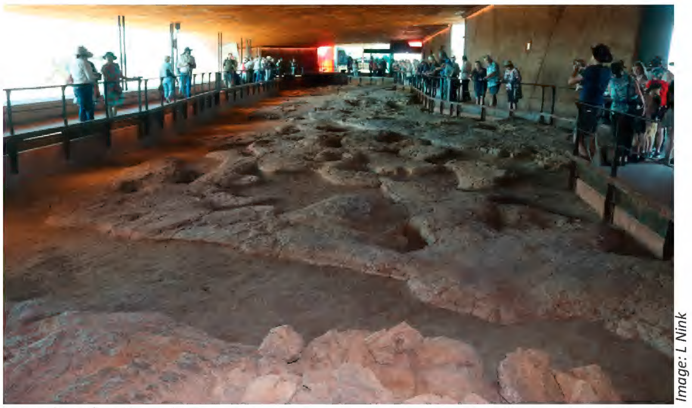


Image: L Nink

The Snake Creek Trackway

Image courtesy of P Vickers-Rich

DINOSAURS ON THE RACV DOORSTEP

BY PAT VICKERS-RICH

The discovery of the very first dinosaur in Australia was made by geologist William Hamilton Ferguson, who was prospecting for coal on behalf of the Geological Survey of Victoria. Three years later, Ferguson published an exquisitely coloured geological map of the area and on it indicated just where that first dinosaur fossil claw had been found, along with a lungfish tooth.

Three quarters of a century were to pass before that discovery was successfully followed up. When it was, knowledge emerged of a unique suite of dinosaurs and a variety of associated biota. Using that map in 1978, geologist Rob Glenie guided two young, aspiring palaeontologists, cousins John Long and Tim Flannery, to the site of Ferguson's discovery. On that visit, John found a fossil bone in a pebble. This demonstrated that Ferguson's discovery was not a fluke. The Cape Paterson Claw, as this discovery came to be called, comes from Eagles Nest, just a little to the west of the current RACV Inverloch Resort. With prospecting over many years and hard work put in at the Flat Rocks site, also not far from the resort, many new discoveries were made over the 40 years that this project and a similar one in the Otways has been under way.

So many Australians, including those who live along the Bass Coast of Victoria, would not have a clue that they have dinosaurs right on their doorstep. More than six years ago, Dinosaur Dreamers installed a dinosaur exhibition at the RACV facility near Inverloch with the gracious offer of space by the RACV and managers Callin Flint and Carey Norton and their staff. Recently, with significant assistance of Peter Swinkels (who used to be head of Exhibitions at Museum Victoria) and staff at the RACV Resort, a major upgrade of the exhibition was made with:

- The addition of several new specimens;
- A new set of panels designed by Mark Collier at NewArtworx;
- Donation of several paintings by Peter Trusler; and
- A total revamp of the glass cabinets adjacent to the foyer of the RACV entry.

This new expo was installed over a week and fortunately was just completed on the last day it was still possible to travel more than 5 kilometres from home before the COVID lockdown came into place in Victoria. Hopefully, this new installation will find some visitors in the not too distant future. There is also a vision that a proper small museum may be installed at the RACV Inverloch Resort in the future. The sizeable number of volunteers that make up the Dinosaur Dreamers could serve there to make sure that locals, national and international tourists, and school kids can finally be made aware of the unique polar dinosaurs on their very doorstep.

We owe so much to the RACV for their support of this project over many years. Funding for the content, set up and maintenance of this expo over the years has been received from private donations . The hard work of the Dinosaur Dreaming team is able to continue with support of Parks Victoria, Museums Victoria, Swinburne University of Technology, Monash University, the National Geographic Society and Atlas Copco.

One other expo of note, Dinoquest, is on hold but being further developed for both online presentation and travel post lockdowns globally. Time will tell when this is on the move again. Working with the Science Centre Singapore, DigiMagic and DezignFormat, much new content including interviews and documentaries has been created. Watch this space next year as this expo again highlights the polar dinosaurs from Victoria and the more than 700 volunteers that have made these discoveries possible.

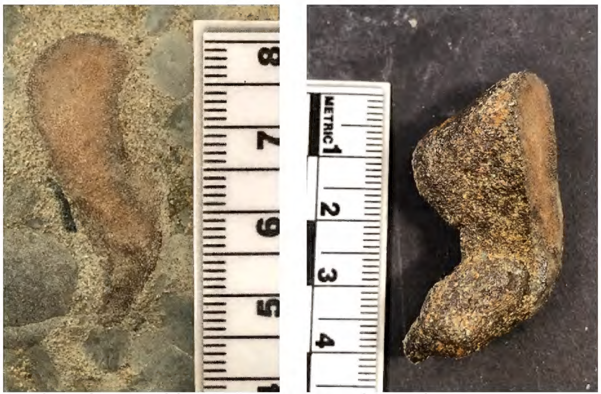
Image: P Vickers-Rich

Peter Swinkels installing the display at the RACV Inverloch Resort

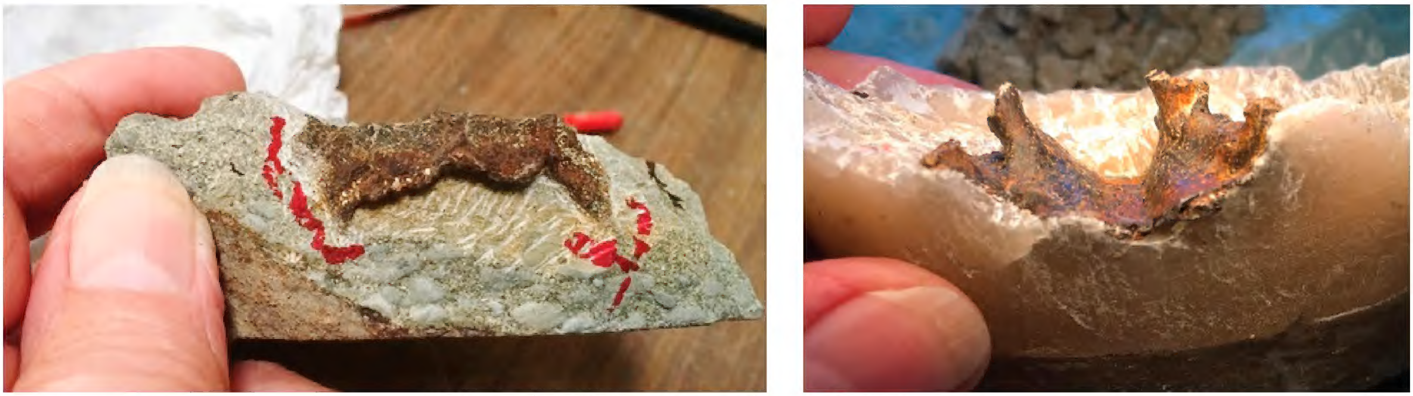
Image: W White

RECENTLY PREPARED FOSSILS

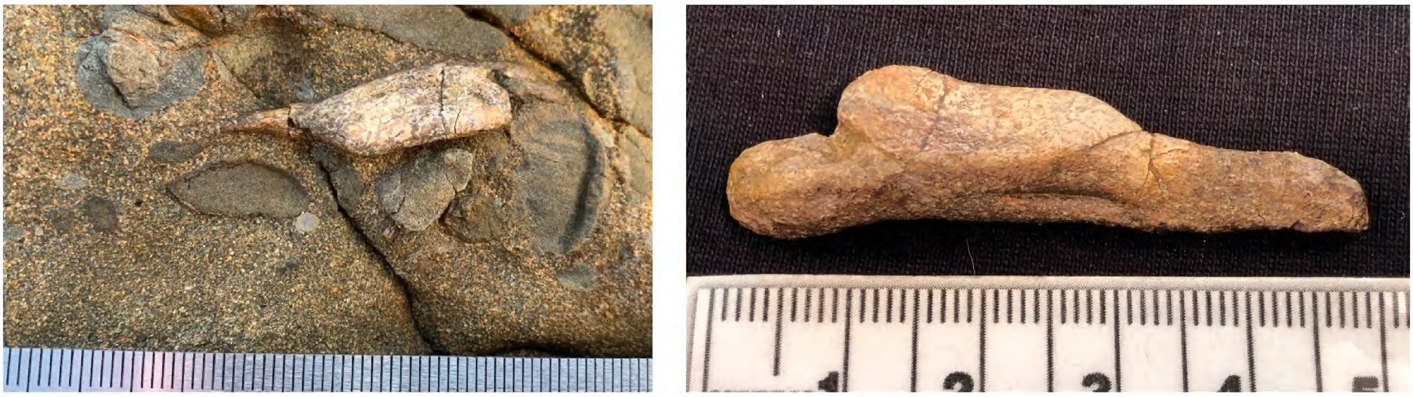
PHOTOGRAPHS BY LESLEY KOOL



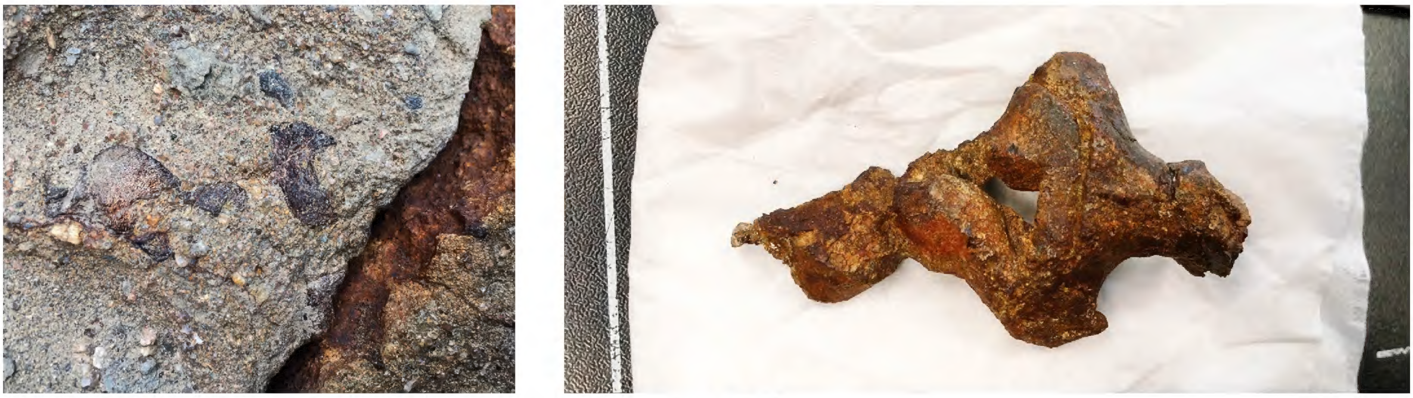
Melissa's weird bone in situ... and in side view



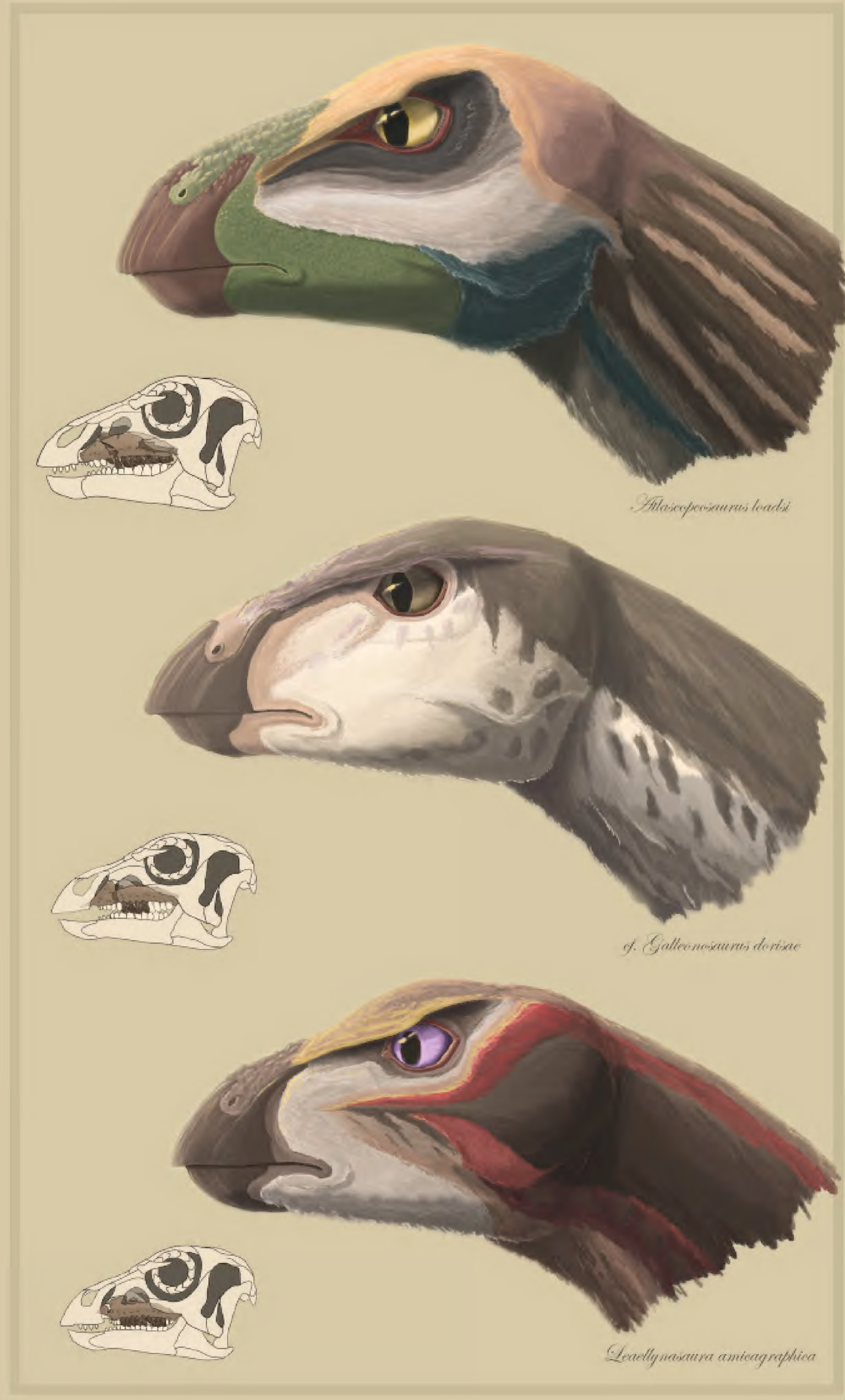
Noddyland skull element in rock... and in wax



The Oaks bone in situ... and after preparation



Mystery bone before... and after preparation



ORNITHOPODS OF ERIC THE RED WEST

VICTORIA, AUSTRALIA

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